DOCUMENT RESUME

ED 414 567 CS 215 943

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TITLE Mathematics and Literature: An Approach to Success.
PUB DATE 1997-05-00
NOTE 126p.; M.A. Action Research Project, Saint Xavier University and IRI/Skylight. Results of the Teacher Math Survey (Table 1) are missing.
PUB TYPE Dissertations/Theses (040) -- Reports - Descriptive (141)
EDRS PRICE MF01/PC06 Plus Postage.
DESCRIPTORS Action Research; *Childrens Literature; Grade 2; *Instructional Effectiveness; *Integrated Activities; *Mathematics Anxiety; Mathematics Curriculum; *Mathematics Instruction; Primary Education; Problem Solving; Program Descriptions
IDENTIFIERS Trade Books

ABSTRACT

This paper describes a program for minimizing students' inability to relate present day school mathematics to real-world experiences, including the high-tech communities around them. The targeted population consisted of second grade elementary students in a growing middle class community located in a suburb of a large metropolitan area in the Midwest. The problems of relating math to real-life experiences were documented with test scores, teacher observations, peer consultations, parent and student surveys, and pre and post inventory tests. Analysis of probable cause data revealed that mathematics education looks more like a relic of the past that is simply inadequate to the challenges of the future. Further data reveals that teachers and parents may pass math anxiety on to their children. A review of solution strategies suggested by authorities combined with an analysis of the problem setting resulted in the development of an integrated math and literature program using natural curiosity about math through children's literature. Post intervention data indicated a reduction of math anxiety by integrating literature into the math program and an increase in the students' ability to problems solve in real-life situations. A well-rounded program should include math games, computer programs, math centers, math manipulatives, and math centered real-life units. (Contains 40 references, and 2 figures and 2 tables of data; appendixes contain survey instruments, parent involvement newsletters, math activities to be done in a family environment, a 29-item list of literature based math lessons, and a 29-item list of trade books.) (Author/RS)

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MATHEMATICS AND LITERATURE
AN APPROACH TO SUCCESS

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An Action Research Project Submitted to the Graduate Faculty of the School of Education in Partial Fulfillment of the Requirements for the Degree of Master of Arts in Teaching and Leadership

Saint Xavier University & IRI/Skylight
Field-Based Masters Program
Chicago, Illinois

May, 1997

CS215943

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CHAPTER 1

PROBLEM STATEMENT AND CONTEXT

General Statement of the Problem

The students of the targeted second grade classes have exhibited the inability to relate present day school mathematics to real-life situations around them. This inability causes math anxiety in many of the students. Evidence for the existence of this problem includes assessments that indicate students are unable to transfer arithmetic facts into problem solving situations. Teacher observations have established that meaningless drill loses the context and does not develop a sense of mathematical functions. Teacher observations further indicate that students are not learning to think mathematically or relate math to their life experiences. Public concerns, which were stated during parent-teacher conference, show dissatisfaction with student's performance in mathematics.

Immediate Problem Context

The primary school referred to in this study contains prekindergarten through second grade and is located in close proximity to the intermediate and middle school sites. As of April 1996, the primary enrollment was 1,785 students. There

were 45 prekindergarteners, 604 kindergartners, 623 first graders, and 558 second graders. These numbers included special education students. The average class size is 28 students. Ethnic characteristics of the student population are as follows: 83.7% White non-Hispanic, 8.25% Hispanic, 5.15% Asian-Pacific Islander, 2.75% African American, and 0.15% Native American. Low income students comprise 2.5% of the population, which is slightly below the district percentage and far below the state. The school consists of 5.4% limited English proficient (LEP) students. This is above the district percentage of 3.3% and slightly below the state percentage of 5.6%. The attendance rate of the school is 94.7%, the student mobility rate is 14.4% and the truancy rate is 0%.

The primary school has 129 staff members, of these, 100 are certified staff and 29 are support staff. The staff is 94% female and 6% male. The average experience level of the teachers is 10.1 years, with 34% having a masters degree or above. There are 3 prekindergarten, 12 kindergarten, 26 first grade and 22 second grade teachers. Special teachers include: six reading recovery teachers, five speech and language teachers, four social workers, three English as a second language (ESL) teachers, three physical education teachers, three music teachers, two learning disability (LD) teachers, two occupational therapists, two psychologists, one math specialist, one reading specialist,one librarian and one nurse.

Major changes have been implemented in the school during the past five years. A literature based approach replaced the basal reading method. Strong components of this program are reading and writing workshops. Reading recovery is part of the first grade reading program. A reading specialist supports at-risk second grade students. Another major change has been the use of manipulatives and hands-on activities within math and science. The school is in the process of a pendulum change, from total pull-out for ESL and LD programs to inclusion. Authentic assessment is being implemented. Staff development is a key focus of the primary school. Due to population growth the allocated class time for music, physical education, and library has been reduced.

The Surrounding Community

The community is located in a northern suburb of a large mid-western city. It is 35 miles from an international airport and in close proximity to a major interstate highway system. The area encompasses 35 square miles, and is comprised of several unincorporated subdivisions and small villages. Within the last decade this community has transformed from a predominately rural setting to a mobile, white collar, bedroom community.

The population of the area is approximately 35,000. The 1990 census shows a population consisting of 93% White non-Hispanic, 4% Hispanic, with Asian Pacific Islander, African American, and native American making up the remaining 3%. According to the district demographic analysis, the overall

population of the community has grown 54% since the beginning of the decade. Although this growth has impacted the school drastically, it has not changed the demographic or economic makeup of the community.

The level of education acquired by the adult community members is as follows: 26% are high school graduates, 24% have some college background, and 21% hold Bachelor Degrees. The median family household income for this area, according to the 1990 census figure, is $45,000.

Employment characteristics of the existing population are represented by major corporations, retail, manufacturing, amusement, health care, military, and educational fields.

The school district is unique in that it is a campus setting, in which all K-8 students are bussed. It is composed of a primary building (K-2), intermediate building (3-5), and a middle school (6-8).

The total district population is 4,700. In five years the projected enrollment is 6,408, a 59.6% increase. The student population is 82.6% White non-Hispanic, 7.8% Hispanic, 5.9% Asian Pacific Islander, 3.4% African American, and 0.3% Native American. Of the student population 3.3% exhibit limited English proficiency.

The faculty population is 215, of which 85.6% are female and 14.4% are male. The faculty consists of 98.1% White non-Hispanic, 0.9% Hispanic, 0.9% Asian Pacific Islander, 0.0% African American, and 0.0% Native American. The Faculty characteristics are: 66.1% Bachelors Degree and 33.9% Masters

Degree and above. The average teaching experience is 10.1 years. There are 169 tenured teachers, and 94 non-tenured teachers. The pupil-teacher ratio is 20.7:1. The pupil-administrator ratio is 398.9:1. The average teacher salary is $34,389. The average administrative salary is $75,903. The operating expenditure per pupil is $4,537. The district administration includes one superintendent of schools, one assistant superintendent of business services, one director of pupil personnel services, one director of building grounds and transportation, four principals, and five assistant principals.

The community is characterized by active parent involvement. The most supportive groups are: Parent Teacher Association, Friends of the School, and Workers of the School. The school has a history of financial and growth concerns. Building referendums have been more successful than educational referendums. A middle school is under construction and will be ready for occupancy August 1997. Some issues currently under consideration are year-round school and reconfiguration of existing buildings.

National Context of the Problem

The problem of relating school mathematics to the real-life situations cause concern at both the state and national level. Conventional beliefs and tendencies of students and adults have delegated mathematics to be a subject meant for a select few. No one wants to admit being illiterate, but it has been socially acceptable to admit

mathematical illiteracy. It is critical to change these beliefs and tendencies in today's highly technological society.

"There is a consensus that all students need to learn more and that instruction in mathematics must be significantly revised,"(NCTM, 1989, p.1). The need for change in school mathematics indicates that new goals in instruction are needed. Our previous curriculum was intended to help train workers for the general work force of shopkeepers, farmers, and factory workers. Although these skills are still needed, the world is ever changing. There is a definite need for all members of society to be equipped with a solid background of problem solving knowledge (Braddon,Hall & Taylor, 1993). Without a meaningful context, students may come to consider mathematics as an abstract and unrelated system. This can give the confused student a bewildering experience.

Industrialized countries have encountered a shift from an industrial society to an informational society. This shift has had a great effect on both the view of mathematics that need to be taught to students and the concepts and methods that they must learn if they are to be self-fulfilled, productive citizens in the twenty-first century. With the changing of society it is becoming more important than ever to be able to adapt to the constant change rather than to simply perform repetitive actions.

The National Council of Teachers of Mathematics(NCTM) sees these changes ahead. Educational goals for students must reflect the importance of mathematical literacy. Five general goals have been established to focus instruction so it will become more productive. These goals see students studying much of the same mathematics currently taught, but with quite a different emphasis. It also sees some mathematics being taught that in the past have received little emphasis in schools. These five goals are:

1. Learning to value mathematics.
2. Becoming confident in one's own ability.
3. Becoming a mathematical problem solver.
4. Learning to communicate mathematically.
5. Learning to reason mathematically.

The intent of these goals is that students will become mathematically literate. This would indicate an individuals ability to explore, to conjecture, and to reason logically, as well as to use a variety of mathematical methods effectively to solve problems. By becoming literate, their mathematical power should develop (NCTM, 1989).

There is no real controversy, but many teachers are concerned about giving up methods that have worked for them in the past. This may reflect underdeveloped math awareness. Traditional training in the teaching of mathematics has been based on the assumption that children must learn arithmetic facts in order to learn to solve problems. However, researchers who study children's thinking have found that it

is actually the other way around. Formal instruction should be combined with the knowledge that students have already acquired on their own, build upon it, and help students to construct mathematical knowledge rather than absorb it. That is, in the classroom, as well as real-life, the solution to the problem rather than the rote learning of facts, should be the goal (Casanova, 1989).

Chapter 2

PROBLEM DOCUMENTATION

Problem Evidence

The researchers gathered evidence through tests and surveys. They used the scores from the Stanford Achievement Test (SAT) to document the extent of their student's difficulty in transferring computation skills into real-life problem solving situations. A baseline math skills survey was developed and administered at the beginning of the school year and again at the end of the intervention. This was to see if the intervention was successful. Three surveys were developed and distributed to the teachers, students, and parents in the beginning of the school year to see if math anxiety existed. These surveys appear in Appendix A. The results of these tests and surveys will be shown and discussed in this chapter and in subsequent chapters.

In order to document the extent of student inability to transfer computation skills into problem solving situations, the scores on the SAT for the past six years were analyzed. A comparison was made of the computation and application scores. The researchers averaged the scores of the classrooms. This comparison is shown in Figure 1.

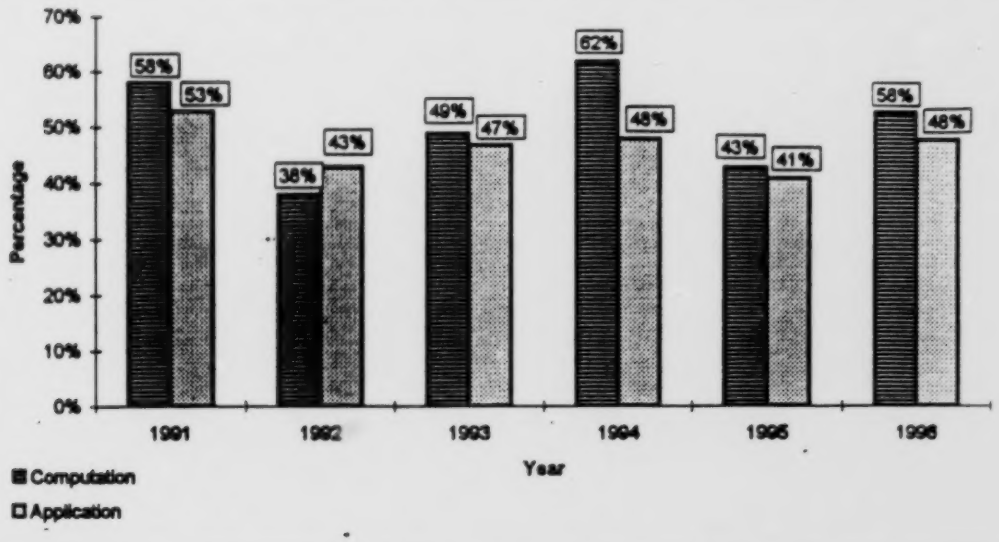

Figure 1. Average classroom scores for computation and applicaton from the SAT over the past six years.

The researchers concluded from the information shown in the graph, that except in the year 1992, computation scores were higher than application scores. This shows that the arithmetic facts are being learned but not transferred into problem solving situations. It should be noted that in the year 1992, the scores showed a reverse of this trend. Upon looking at the actual scores, it was noted that the scores were lower over-all, signifying that the students had a total misunderstanding of information. The researchers feel that this could indicate that the students guessed on the test.

Through teacher observations during class discussions and small cooperative group time, it was noted that many students learn computation skills and rules by rote, which

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often masks students' lack of understanding and reasoning in math. Students are learning only part of the components taught to them. They lack the ability to focus on the whole picture. Consider the following problem:

> There are 125 cows and 5 dogs on a farm.
> How old is the farmer?

The following solutions that a student could reveal indicates the kind of misinformed conception of mathematics that many students hold:

```
125 + 5 = 130 ......this is too big, and
125 - 5 = 125 ......is still too big ...while
125 / 5 =  25 ......That works! The farmer is
                    25 years old.
```

In this example mathematics is seen as a set of rules, a collection of procedures, that must first be memorized and then correctly applied to produce the answer.

Our nation has produced a generation of students who engage in problem solving without regard to common sense or the context of the problem.

Probable Causes

Literature suggests several underlying causes for the existence of the problem areas. Four prominent themes seem to dominate the literature. These themes are: 1) A Changing Society; 2) Staff Development; 3) Math Anxiety; and 4) Real-life Problem Solving. The researchers will be addressing these themes one at a time, linking the literature with the probable causes inherent at the site itself.

Our society is changing at a rapid pace. According to Marshall (1990), we can no longer behave as though we are educating future workers for the assembly line. An

informational society is replacing the community of farms and factories. It is becoming more important to adapt to constant change than to perform repetitive actions.

The students we educate today can expect to change jobs many times during their lifetime. The jobs they hold will develop and change around them. They must reason clearly and communicate effectively (Carl, 1989).

As our world becomes smaller our responsibilities in international affairs continue to increase. According to Steen (1990), as the demands of society change, so does the essential competency needed by individuals to live productively in that society. All students, including those of all races and both sexes, will need competence in essential areas of mathematics. Many areas of mathematics that are commonly used in the workplace are rarely taught in school, while other topics that have long since outlived their usefulness remain in the curriculum.

At the targeted school there is also much change. In the last decade the community has gone from primarily working class families to middle-class professional families. This has resulted in an increase in population which has caused over crowding in our classrooms. From 1990 to the present, the student population has increased by approximately 2,000 students. This is an increase of 59.6% (Lake County Department of Planning, 1995). During this period of many changes some of the teachers of the targeted district are

still holding on to the old methods of teaching, although the curriculum is current with the times.

The second theme, staff development, is an essential step in bringing about the needed change in the instruction of mathematics. Materials for mathematics are often chosen by non-instructional personnel, without consulting the classroom teacher. Frequently, the teacher receives the materials with little or no training in their use. This results either in ineffective use with students or simply in neglect and storage in the back closet. The researchers are still trying to figure out what to do with the attribute blocks that they received five years ago. Until recently, the unifix cubes were used as an indoor recess activity. Unfortunately, this situation often concludes with a decision by teachers that hands-on materials are not useful tools for mathematical instruction.

Most of the newly piloted programs provide teachers with training on how to use the programs. Time will tell if the improvements documented so far will last and whether they can be duplicated in schools where no professional development is offered along with the new materials.

The targeted school has provided inadequate staff development in various programs installed in the math curriculum. There is also little reinforcement of the "one shot" training. "They can't get away with buying a book and handing it to a teacher."(Viadero, 1996, p.4). In depth staff development is a must.

The third theme, math anxiety, has been defined in a variety of ways. Math anxiety involves feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems (Richardson & Suinn, 1972). Tobias and Weissbrod (1980) stated that the term math anxiety was used to describe the panic, helplessness, paralysis, and mental disorganization that arises among some people when they are required to solve a mathematical problem. According to Lazaruz (1974), "Mathophobia is an irrational and impeditive dread of mathematics" (p.16). A concise description of math anxiety is that it is both an emotional and a cognitive dread of mathematics (Hodges, 1983; Seguin, 1984).

Most math anxiety has its roots in the teachers and the teaching of mathematics. Parents and teachers sometimes pass math anxiety on to their children and students (Williams, 1985). Most math anxious people can probably trace the cause of their anxiety to some of the following: timed tests, over emphasis on right answers and the right method, working at the black board in front of peers, lack of acceptance of nontraditional problem-solving methods, and such negative counseling as, "You won't need this," or "You aren't smart enough to learn this." Many of these procedures are practiced in the targeted school.

According to Lester (1989), research informs us that young children begin school having already learned quite a lot of mathematics from their everyday problem solving. They continue to create and acquire new mathematical

procedures on their own throughout the years they spend in school. The problem is that schools often suppress these naturally developed methods.

The researchers strongly identified with the literature on math anxiety, both being products of the elementary school systems of the late fifties. Although some of the citations are dated, the researchers felt that they were pertinent to their own math anxiety. Therefore, the possibility of passing math anxiety on to their students was a concern.

Math learning is largely a function of math teaching and math anxiety may also be a function of math teaching. The researchers surveyed 26 teachers in the targeted school to establish the existence of math anxiety among the staff.

The majority of the teachers surveyed, preferred teaching math in the morning. Several of the teachers made the comment that in the past they had preferred to teach math in the afternoon. The targeted district had a schedule adjustment about five years ago which made it almost impossible to teach math any other time but in the morning. Now that they have been teaching math in the morning for a few years, they find that they actually like it better. This does not mean math is a positive time for all of these teachers. Some stated that they previously taught it in the afternoon to put it off and now they are teaching it in the morning to get it over with for the day. Table 1 depicts the results of the Teacher Math Survey.

The next two questions on the survey dealt with students math anxiety and math anxiety contributing to low math achievement in some students. The majority of the teachers surveyed felt that math anxiety could be a contributor to low math achievement in some students.

The last two questions dealt with their knowledge of the NCTM. Of the teachers surveyed, 58% had heard of the NCTM, but only 27% of the teachers had ever read the NCTM Curriculum and Evaluation Standards.

The researchers feel that the results of the survey indicated an existence of math anxiety, but the degree of math anxiety in teachers was not as great as that of the researchers themselves. The survey also indicated that if the date of graduation of the teachers had been taken into consideration, the results would have indicated that teachers who graduated in the past eight years or less had heard of the NCTM and read parts of it in a college class or Masters Program. Teachers who had graduated over eight years ago had heard less of the existence of the NCTM.

The students of the targeted classrooms were also surveyed to find evidence of existing math anxiety, The results of this survey are shown in Table 2. The researchers surveyed 60 second grade students in classrooms A and B. The overall results of the Math Attitude Survey showed that more than 75% were excited or happy about math, math games and questions about math. When it comes to worksheets and math class, the over all results were in the 60th percentile. While on the question about learning new things in math, the

survey showed that 90% of the students had a positive attitude toward math. Students feeling that math was easy fell into the the 70th percentile range, where as the students that felt math was hard for them was in the 20th percentile range.

Table 2

Results of the Student Math Anxiety Survey

Survey Question	Responses	
	Excited/Happy	Grumpy/Angry
1. How do you feel about math?	78%	22%
2. How do you feel about math games at free time?	83%	17%
3. How do you feel when the teacher asks math questions?	78%	22%
4. How do you feel about doing workbook pages and worksheets?	62%	38%
5. How do you feel about math class?	64%	36%
6. How do you feel about learning new things about math?	92%	8%

The researchers feel that the survey showed many of the students answered the survey to please the teachers, thinking it was the right way to answer the question. When the researchers observed the children actually doing math

activities, they noticed a fair amount of tension and nervousness among students who had answered that math was easy.

Merseth (1993) stated that when children come home and ask questions about mathematics, parents often answer defensively that mathematics was always hard for them or that they always found it something of a mystery. The message is, "Don't ask me about that! It's not something I value." The researchers surveyed the parents of the targeted classes to verify the probability of the existence of math anxiety. Although about half of the parents surveyed had negative feelings about math, they still felt their children enjoyed math. It is difficult to tell how a child feels about math at such an early stage of mathematics. When parents were considering whether their child liked math or not, they seemed to think that math was computation. Application or problem solving was just a segment of it instead of being the goal of mathematical thinking. Their examples were of the computation variety, such as: He likes adding and subtracting. She likes counting money. The survey showed that fathers had a more positive experience with math than the mothers. Although the mothers liked math less then the fathers, there were more positive experiences then expected. Could it be that when the parents were in school as children, more attention was given to gender bias then when the researchers went to school?

Table 3

Results of the Parent Math Anxiety Survey

Survey Question	Responses	
	Positive Feelings	Negative Feelings
Does your child like math?		
Mothers	79%	21%
Fathers	90%	10%
What were your feelings about math when you were in school?		
Mothers	56%	44%
Fathers	64%	36%

When parents were commenting on their math experiences, positive or negative, their comments were generally on high school math. One of the negative comments was: "I liked math until I reached high school." Positive comments included, "It was boring until I reached high school." The researchers found that the survey was inconclusive to the subject of math anxiety being passed down from parent to child.

> The ability of individuals to cope with the mathematical demands of every day life - as employees, as parents and citizens - depends on the attitudes toward mathematics conveyed by school experiences. Mathematics can neither be learned nor used unless supported by self-confidence built on success. (Steen, 1990, p. 22)

The fourth theme, real-life problem-solving has been ignored in the teaching of mathematics. Over 175 years ago, Pestalozzi advocated that classroom activities should be

based on the actual real experiences of children and deal with matters which interested them outside of school. He suggested that abstract arithmetic concepts could best be taught through the use of concrete objects (Berman, 1982). Today, this is still a major concern.

In 1989, the National Council of Teachers of Mathematics published a set of student-achievement standards that had the possibility to reform the math that is taught in schools across the nation. The standards emphasized teaching students to reason, think, and communicate mathematically. NCTM suggested placing math in the context of students' everyday lives, and stressed giving students' hands-on activities and access to calculators and computers to use as problem-solving tools (Viadero, 1996). Although these standards have been around for a number of years, the researchers have noticed little knowledge of their existence in the targeted school.

Only a few studies have investigated the mathematical behavior of children in out-of-school settings. Lester (1989), found that those who were capable of solving a computation problem in a natural, everyday setting often failed to solve the same problem when it was presented to them out of its context. It was suggested that the reason for the superior performance in everyday contexts was that in natural settings the youth used their common sense and relied on mental calculations that were closely tied to the quantities involved in the problems. Contrary to the above, their attempts to solve the more formal school-like problems

typically were limited to the rote manipulation of symbols.

To a large extent, school mathematics bears little resemblance to the kinds of problems with which people are confronted in out-of-school settings. Even more important, school tasks often require little or no understanding to get correct answers.

To ensure effective learning, mathematics teachers must involve children in their own learning by using classroom strategies that make students active learners rather than passive receivers of knowledge.

In conclusion, the four prominent themes that dominated the literature and were inherent at the site were the changing of society, staff development, math anxiety, and real-life problem-solving. Of these four themes, a changing of society has already taken place. It is a probable cause of math inefficiency. Instead of ignoring the changing of society, the nation needs to adapt to these changes. At the targeted site, the planning of staff development is not an area open to the involvement of the teachers.

The remaining themes, math anxiety and real-life problem-solving, hopefully, will be the two areas the researchers make an impact on at the site. Teachers' actions do make a difference in affecting students' achievement.

Chapter 3

THE SOLUTION STRATEGY

Literature Review

The literature search for solution strategies has been narrowed to the following four areas: 1) A Changing Society; 2) Staff Development; 3) Math Anxiety; and 4) Real-life Problem-solving.

A Changing Society

The changing society has a valid concern about the basic skills and knowledge of our students. The goal of education is to develop informed, thinking individuals, able to perform in today's complex society (Branddon, Hall & Taylor, 1993). Unity does not exist in American Educational goals. Math fact drill still exercises a powerful hold. Going backward to the old basics of drill and computation is no longer an option. Education needs to go forward if we are going to compete in the ever changing world (Marshall, 1990).

The NCTM Curriculum and Evaluation Standards (1989), differ from what has been done in the past. The standards emphasize applying mathematics over mathematics computation; spending less time on rote drill and more time on problem-solving; using computers and calculators as "fast pencils" during the course of problem-solving; seeing mathematics as an integrated whole rather than as a series

of isolated topics; learning the meaning of operations such as addition and multiplication, as well as simply learning the operations. Two attitudes need to be changed in today's educational society. First, memorizing basic math facts is still very important. However, memorizing basic facts is better taught after the students have realized a purpose for these facts, not before students are allowed to do mathematics, which is generally what has happened in the United States. Second, the extent of mathematics should be taught as soon as students have a reason for using this information in relating mathematics to their world (Corwin, 1993).

Staff Development

New visions for staff development are in the forefront of reform. To attract and keep the best and brightest people in the profession, it is critical to support the on-going development of teachers. Teachers who have the opportunity to learn and grow can best give such opportunities to their students. Instead of being seen as a series of in-service workshops, staff development needs to be both a norm and a value, made available through a wide variety of approaches that contribute to learning (Loucks-Horsley, Phlegar & Stiegelbauer, 1992). Staff development is an on-going learning for teachers and anyone involved with working toward the goal of student success. It should not be seen as a secondary activity; or as something to make people feel good in the short term sense. A shift should be made to comprehensive staff and professional development standards

that range from graduate courses to in-depth residency training seminars. It is part of everything that happens within the school as a community. Teachers should push themselves to create the professional learning environments they want. Mandated educational programs will succeed no better than mandated assertive discipline or mandated anything. It is essential that each teacher volunteer to enter these educational programs. Once the teachers are exposed to a one day awareness program for all staff, volunteers can then be solicited. After the first volunteer team has completed training, others will become interested. Only volunteers will be accepted, right down to the 10 percent of resisters. Concentration on the teachers who are following the new program is more important than the resisters (Bellanca & Fogarty, 1991). Staff development should be a learning-by-doing situation. Within a supportive environment, teachers should be evaluating, gathering new knowledge, trying it out, and trying it again. New information should be linked to prior knowledge, reflecting, and solving problems (Fullan, Bennett, & Rolheiser-Bennett, 1990). Within the context of staff development the following area needs to be addressed. Teaching as telling can no longer be the main form of instruction in mathematics classrooms. Instead, multiple opportunities must be provided for students to engage with mathematics (Merseth, 1993).

Math Anxiety

Math anxiety is another area to be considered for improving the mathematics learning in our nations schools. "On the presumption that math anxiety is transmittable, Bulmahn and Young (1982), proposed that mathematics specialists be provided in all elementary schools as a cure or preventive measure for the communicable disease of math anxiety that is being carried by elementary teachers to untold generations of the student population" (Williams,1985, p.51). Because Greenwood (1984) and others contended that the cause of some math anxiety lies in the teaching of mathematics, a possible solution to the problem of math anxiety may lie in the preparation of teachers of mathematics. Stodolsky (1985) said that the teaching of mathematics suffers from the lack of applied activity and experience. It may be equally true that traditional methods courses for the teaching of mathematics suffer from the same ailment. Some new strategies include working in small groups, using a variety of problem-solving approaches and using concrete materials for modeling concepts. There are a variety of approaches that can help lessen or prevent math anxiety in some students. Teachers need to accommodate the various learning styles of their students, be it visual, auditory, or kinesthetic. The new variation of learning styles is to consider the multiple intelligences. Math must be made relevant to the child's setting. The classroom atmosphere should be examined to determine if students are freely asking questions. If students do not seem to be

freely asking questions, a change of the classroom atmosphere from one of tension and/or competition may result in more willingness of students to ask questions. Empathize rather than criticize. Negative reactions by others can cause a lessening in class participation. Positive math experiences should be provided. Essential to this suggestion is the knowledge of individual students' math strengths, weaknesses, and attitudes toward mathematics. In some cases a teacher needs to practically guarantee a weaker students success in solving a problem. The use of games that provide original thinking, intuition, and build confidence will foster this success. Do not be afraid to let students see you make a mistake (Dunn, 1986).

It's also true that approaching mathematics through literature is often easier to understand for many students and teachers who have found earlier experiences with mathematics unpleasant (Braddon, Hall & Taylor, 1993). Linking math and literature in the classroom will help students gain confidence in their mathematics abilities, learn problem-solving, and develop other valuable math skills while enjoying literature (Kolakowski, 1992).

A fitting conclusion to this section would be a quote from Williams, (1988):

> Tell me mathematics and I will forget; show me mathematics and I may remember; involve me in a tension-free atmosphere in small group work and with manipulative aids in mathematics and I will understand. If I understand mathematics, I will be less likely to

> have math anxiety, and if I become a teacher of mathematics I can thus begin a cycle that will produce less math anxious students for generations to come. (p.100)

Real-life Problem Solving

Students should be encouraged to create and solve problems directly related to the world around them so they can see the patterns of mathematics in every aspect of their lives. Concrete experiences and materials provide the bases for understanding concepts and building meaning (Zemelman, Daniels & Hyde, 1993). Helping students develop clear, correct concepts in mathematics is a major task for teachers in elementary schools. There is much concern about the mathematical competence of our students. There has been a slight improvement in the mastery of basic facts, but in the area of problem-solving and critical thinking there has been little improvement. In a mathematical curriculum focusing on problem-solving, there need to be relevant, challenging problems for students to solve. The most involving problems initially come from real-world contexts and offer opportunities for expansions that are limited only by the problem-solving abilities of the students themselves (Carey, 1992). Problem-solving is usually weighed down by the interference of computation skills. With the use of calculators and computers many of the paper-pencil procedures need not and should not consume such a large part of the students time in school. It is more essential to use this

time in realistic problem-solving strategies. These strategies require teachers to shift from the traditional role as lecturer-demonstrators to a role that demands new skills in planning and facilitating student work. One approach is to have students explore and discover new concepts for themselves. This gives them the opportunity to actually "do" mathematics rather than passively learn about mathematics. The discovery approach challenges the students to think more deeply about the concept and to create explanations of it that connect with their prior knowledge in a personally meaningful way. This does not mean to leave the student alone and he will discover what he needs to know. That can often be disastrous. Facilitating students' discovery of mathematical concepts requires far more than an approach in which the teacher does little other than stay out of the way (Simon, 1986).

Another strategy is the use of cooperative learning in which students work together in pairs or small groups. Traditionally this approach has not been part of mathematical classes. Two important benefits result from pair and group problem-solving. First, students are exposed to diverse thinking and problem-solving strategies. Second, they develop metacognative skills - knowledge about their own cognitive processes and the ability to use them (Bellanca & Fogarty, 1992).

Writing should also be required. Nothing helps a student learn a subject better than having to write about it. Writing in a mathematics class helps students learn to

communicate about mathematics and as they put their ideas into logical written form, their own understanding becomes clearer. Many teachers have reported positive results in students understanding of math concepts with the use of journal writing (Steen, 1990). Journal writing also helps the teacher. When students describe their thinking processes in writing, they display their level of understanding in a way that is much more revealing than by simply filling in worksheets and textbook assignments.

Opportunities should be provided for students to demonstrate their thinking processes used in solving a problem. By having the students describe their thinking process and verify their solutions, it helps them to develop a deeper understanding of mathematics. In presenting their work to the class, it lets them hear each other's thoughts and receive feed back on their own ideas (Burns, 1988).

Teachers should enrich learning by posing questions, asking students to clarify and support their ideas, and challenging students to ask for help from one another (Hatfield & Price, 1992). Raising a question about an idea that does not fit in with a student's present understanding is the sign of an inquiring learner. Questions are essential for speeding up the process of making connections and for reflecting on what we know. To help students find writing, discussing, and questioning a meaningful part of mathematical activity, teachers need to provide a communication-rich classroom environment. Here in lies the place of children's literature. The power of books can help them achieve the

important mathematical goals of the NCTM (1989).

Literature can help learners value mathematics. Books show people using mathematics for a variety of purposes. They help students see mathematics not as an abstract system of meaningless symbols but as a useful tool for solving problems and making decisions. Children's literature can restore a meaningful context to mathematical learning.

Literature helps learners build their confidence in their own mathematical abilities. Many students see mathematics as a system that is simply too abstract for them to understand. Books can help change this attitude because they provide a low key, non-threatening source for the exploration of various mathematical ideas. Language and discussion are a natural step from books to mathematics.

Literature encourages learners to be mathematical problem-solvers. Books can be a spring board for students to create and solve their own mathematical problems. A problem solving approach is implicit in many books that children are exposed to during story time or a literature based reading lesson. By using literature, something that the student is already familiar with and comfortable with, mathematics will appear to be an old familiar friend instead of something new and frightening.

Literature provides a meaningful context for students to communicate mathematically. Books help students think about classifying familiar objects into sets that make sense for them. Students are also encouraged to communicate this information to others.

Literature supports learners in reasoning mathematically. Mathematics is the science of reaching necessary conclusions. Strategies that involve acting out and creating drawings are important for problem-solving and support learners in trying to eliminate possibilities and to think deductively. In summary, children's books can be an important vehicle for addressing these students goals set forth by the National Council of Teachers of Mathematics. The following quote by Griffiths and Clyne explains the use of literature and mathematics very clearly.

> Mathematical ideas and concerns are present in literature of all kinds today, and indeed the purposes or functions of mathematics and literature are closer than might at first appear. One function of mathematics is to order the world around us. So does literature. Mathematics is concerned with classification. So is literature. Mathematics is concerned with problem-solving. So is literature. Mathematics looks for relationships. So does literature. Mathematics involves patterns. So does literature. And mathematics and literature both have aesthetic appeal. Without taking this analogy too far we contend that mathematics and literature have strong links, both in content and in structure, and that these links should be explored to make more effective the understanding of both mathematics and literature. (1988, p. 4)

Integration of subjects is not a new idea. The concept of integrating curriculum by teaching theme units that connect all subject areas with a central theme has been around since the 1930's (Andersen, 1993). The reason for organizing the curriculum this way is to present learning experiences that are more closely tied to real-world situations and to promote higher level thinking. The world outside of school is generally not divided neatly into reading, writing, math, science, and social studies. It is up to the teacher to help the students to make meaningful connections between subjects and the curriculum goals for those subjects.

Math is a more difficult area to integrate. Math needs to be taught in a sequential way, building skill upon skill for better understanding. This sequence does not always lend itself to easy integration into content area themes. It is important for students to see ways that math is applied in real-life problem-solving situations. The solution seems to be to continue to teach math for a small part of the day in a sequential way, but to incorporate math concepts and ideas as often as possible in integrated units.

Literature is a natural way to introduce new math concepts within the classroom. Children love to listen to stories and are anxious to become part of them. Stories require children to listen, interpret, and reflect on the content. Stories also help to explore math concepts through active participation, to integrate new ideas, and to predict new outcomes.

Mathematics should not be forced upon a work of literature. This would defeat the purpose of integrating the subject areas. Rather, the mathematics should flow from, and be a natural part of, the book. Not all mathematics can or should be taught through literature. Real-life experiences, games, manipulatives, and appropriate worksheets or pages from a text book all have their place in mathematics programs. Using literature to teach mathematics is an additional and very useful strategy to add to teachers' storehouse of techniques (Griffiths & Clyne, 1988).

Children's trade books that are appropriate for supplementing mathematics instruction can be separated into four broad categories. The first category includes counting books. In addition to their being used to develop and reinforce counting and number concepts, these books can be used to introduce addition and subtraction. Another kind of children's book is the number book, in which a specific number is stressed. This assists the student in understanding the meaning of the number. The third type of book is the miscellaneous storybook. These may be fairy tales, folktales or other stories in which the author touches on a mathematics concept. The fourth group of children's books includes concept, or informational, books (Gailey, 1993). The purpose of these books is to explore specific mathematical concepts. Of these four categories, the concept books stimulate further investigations of mathematics concepts.

The purpose of including the concept book in mathematics programs is to add an extra dimension to the traditional mathematics lesson. Such resources enhance the investigation of a mathematics concept by deepening and extending it. Features of concept books are many. Good concept books have interesting formats and appropriate sizes of type. Their text and illustrations communicate excitement in exploring mathematical ideas. It must be accurate in its social and economic setting. A good concept book is carefully organized and the content is presented from the simple to the complex and from specifics to generalizations in a logical sequence. The material is written so that students can understand it, using vocabulary that they can comprehend (Whitin & Wilde, 1992).

Limon (1993) presents the following steps for developing activities and establishing an environment that will help to incorporate literature into an integrated math program.

1. Begin with a mathematically rich story, that is both delightful and engaging.
2. Have students become physically involved in the story through role playing.
3. Help students see the function mathematics plays in the story.
4. The mathematical concept needs to be appropriate to the story.
5. Have students read stories involving creative mathematics.

6. Have students reflect, share, and discuss with classmates to establish an environment that invites communication.

Weaving literature into math is a wonderful way to tap the talents of all students, no matter what their ability levels may be. The line between "good" readers and "good" mathematicians begins to fade. Children are more likely to build their confidence in each area and to focus less upon what they see as their strengths and weaknesses in school subjects (Thrailkill, 1994).

Project Objectives and Processes

As a result of integrating literature into the math program, during the period of September 1996 to December 1996, the second grade students from the targeted classes will decrease their anxieties toward mathematics and increase their ability to problem-solve in real-world situations, as measured by the math skill survey (post-tests), student surveys, and teacher anecdotal records.

As a result of sending monthly parent involvement letters, during the period of September 1996 to December 1996, the second grade students from the targeted classes will increase their ability to relate problem-solving to real-world situations, as measured by student surveys and parent comments.

As a result of sending family math bags home, during the period of September 1996 to December 1996, the second grade students from the targeted classes will decrease their anxieties toward mathematics and increase their ability to relate problem solving to real-world situations, as measured by parent comments.

In order to accomplish the terminal objectives, the following processes are necessary:

1. The development of an integrated math and literature program, using natural curiosity about math through

children's literature. Literature will provide a bridge to integrate authentic experiences with math (Whiten and Wilde, 1992).

2. Monthly parent involvement letters have been designed to assist parents in helping their child develop mathematical concepts and build vocabulary. Through the suggested activities, parents can help to foster an attitude of curiosity about numbers and shapes (Ashlock, 1990).

3. Family Home Math Bags have been created. The purpose of these activities is to help children acquire a better understanding of some mathematic concepts and enjoy working with their family in an out-of-school setting (Bendery and Bjelopetrovich, 1994).

Project Action Plan

The researchers have designed and will administer baseline surveys for the parents and students, (see Appendix A). The surveys were written in the summer of 1996 and will be administered during the first and second week of school. The purpose of the baseline survey is to note math anxiety among the students and their parents. The students will also be given a math skills survey to pin point their weak areas, (see Appendix B). The purpose of the math skills survey (pretest) is to serve as baseline to measure growth at the end of the implementation project.

The expected and unexpected interruptions during a routine classroom day make it difficult to be precise in the

weekly planning schedule. The following schedule will be adhered to as closely as possible.

Week 1

A. Researchers and students will be getting to know each other through fun math and literature activities. Example: Chrysanthemum by Kevin Henkes will be linked to graphing.

B. Disclaimer letter and parent survey will be sent home.

C. Teacher oral survey (math anxiety) will be administered.

Week 2

D. Administer the student survey.

E. Administer the baseline math skill survey (pretest).

F. Researchers will analyze the information from the math skills survey and compile a list of weak areas.

G. The parent and student surveys will be compiled and a conclusion will be drawn for evidence of math anxiety.

Week 3-12

I. Parent involvement letters will be sent home near the beginning of each month. (Appendix C)

J. Two Family Math Bags will be rotated among the students on a weekly basis until all students have had the opportunity to share the varied activities with their family. (Appendix D)

K. The integrated math and literature program will begin. The researchers will create

literature-based math lessons to support the site's math curriculum. The goal will be an average of two literature-based math lessons a week. (Appendix E)

Week 13 L. Administer the student survey.

M. Administer the baseline math skills survey.

N. Collect parent surveys from the family home math bags. (Appendix F)

Method of Assessment

In order to assess the effects of the intervention, math skill surveys will be re-administered. The word "test" was replaced by the word "survey" in order to lower math anxiety in the students. This will be compared with the same survey given in September. The student survey on math attitudes will be re-administered to show if a change in math anxiety occurred. The parent comment sheet in the Family Math Bag will be assessed.

Parents comments on the home involvement letters will be solicited at conference time. Authentic assessments will be developed as needed. The reflections from the teachers journal entries will be part of the assessment process.

CHAPTER 4

PROJECT RESULTS

Historical Description of the Intervention

The objectives of this project were to reduce math anxiety by integrating literature into the math program and increasing the student's ability to problem solve in real-world situations. The three-fold implementation plan included the integration of math and literature, parent involvement letters, and family math bags.

Math and Literature Implementation

Math and literature lessons were implemented to help alleviate math anxiety while increasing problem-solving abilities through real-life situations. The skill areas chosen to concentrate on included: problem-solving, graphing, measurement, classification, number patterns, and time/money. Two lessons a week were taught. Authors and topics were chosen that children would relate to best. A lesson consisted of a story that corresponded to a math topic. The literature used created questions to propel mathematical understanding. From there, a lesson or project was created.

The problem-solving activities included the manipulation of objects to create and/or solve problems. The students were read a story that lead to questions that could be solved

by manipulating an assortment of objects. Sometimes the students were asked to create a project to show their conclusion. Journaling was used as a way to show how they solved the problem. At the beginning of the intervention the students had to be led through the process of problem solving. This was expected because problem-solving was a weak area. Problem-solving was modeled by the teacher. Another type of problem-solving involved situations which could be considered real-life. After being read a story the students were asked to solve problems involving facts from the story. The additional information from the story helped the problems come to life. In one activity problems were more personalized. The students completed a story by filling in blanks using their names and numbers chosen by them. They then broke into groups and solved the problems together.

There were five graphing activities involving bar graphs, pictographs and graphing coordinents. Graphing put the numerical information into an easily read form to represent otherwise confusing facts. Graphing helped the students learn about one another in a positive, nonthreatening way. For example, in one activity the students graphed the number of letters in their name, there by, putting the activity into a real-life situation.

The measurement activities covered two areas: linear and mass measurement. To introduce the students to linear measurement they were read a story about the history of measurement. This story lent well to their own investigation of the comparison of standard and nonstandard measurement.

Several other stories also involved linear measurement. They emersed the students in real-life fact finding by measuring different parts of their body. The celebration of Johnny Appleseed lent to the investigation of mass and linear measurement, involving real apples. A follow up activity was used at Halloween with pumpkins.

Classification is a crucial concept for young children to understand before any meaningful number work can begin. A classification story about buttons was read. The students used buttons and a variety of other objects for sorting and categorizing. Learning to classify helps to develop a flexible thinker.

The number pattern activities involved fact families, odd/even, and doubles. Understanding fact families is a difficult concept for many students to understand. The use of a poem allowed the students to make up their own problem from which fact families were illustrated. In another story activities and games were used to present different ways of thinking about even and odd numbers. These activities showed examples of even and odd numbers in real-world context. The activities appealed to different levels of understanding. Take house numbers, for example. What is your house number? Is it even or odd? The students at the targeted school are placed in their building by the odd and even numbers in their address. This was a demonstration of real-life use.

Learning about time and money are abstract and complicated for young children because of the many different combinations that stand for the same thing. A literary

series has been developed that includes many activities and games to give the students first hand experiences that help them learn about time and money. In these books the children were given activities they could do with a partner using manipulatives of coins and clocks. Activities using these physical materials helped make abstract mathematical ideas concrete. In one of the activities the students were surprised at how long a minute was when they weren't doing anything and how short it was when they were timed on something.

Parent Involvement Letters

The monthly parent involvement letters were developed by the researchers to help show parents and their children the many ways that math is involved in their real lives. One letter was sent home each month explaining activities for the parents to use with their child in and around the home. Each letter involved a different subject. These subjects were: At the Toy Box, In the Kitchen and Dining Room, Around the House, In the Garden, In the Yard or at the Playground, In the Car, At the Store or Restaurant, and In the Neighborhood and Beyond.

Family Math Bags

The Family Math Bag contained several different math activities. Each activity included directions and the necessary materials. These activities were meant to be done in a family setting. The purpose of these activities were to help children acquire a better understanding of some mathematical concepts and enjoy working with their family.

The Family Math Bags put math into a familiar real-life situation for the students. Two math bags were sent home on a rotating basis with two different students each week.

Presentation and Analysis of Results

In order to assess the affects and use of literature based math lessons a pre and post math skills survey was administered. The results of the pre and post survey are presented in Figure 2.

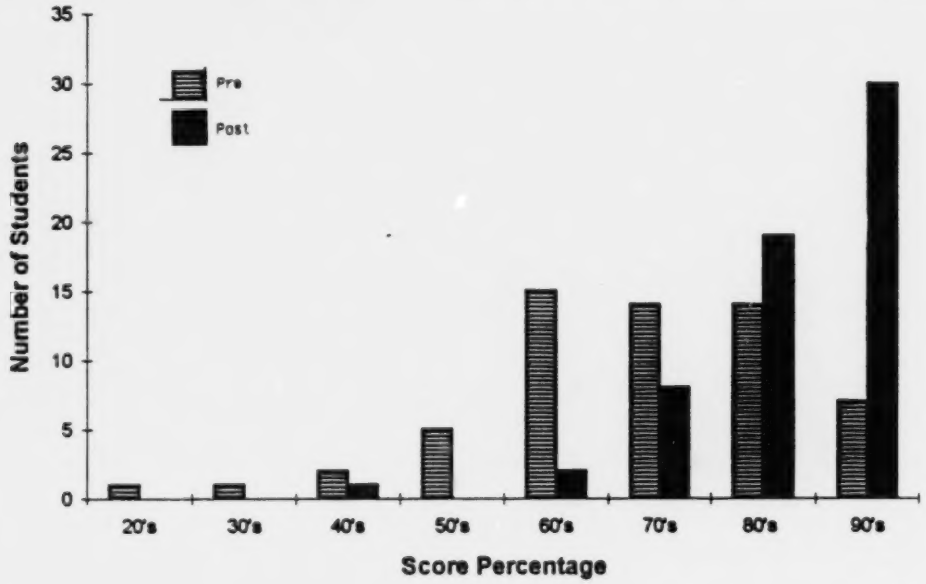

Figure 2 Pre and Post Math Skills Survey

The intervention appears to have had a positive effect on the students math skills. Of particular note is the growth in the scores from the pre survey to the post survey. The scores of the surveys were converted into percentages. The pre survey mean was 73%. The post survey mean was 87%.

This is an increase of 14% in the mean. Even the weakest student made gains of approximately 20%. The school district considers 80% of any assessment to be mastery of a skill. The pre survey had 21 students out of 60 students at the mastery level. The post survey shows a significant growth with 49 students out of 60, at the mastery level. That is an increase of 28 students who now demonstrate mastery in basic math skills.

Math Anxiety

At the time of the first survey on Math Anxiety the researchers felt the survey showed many of the students answered the survey to please the teachers, thinking it was the right way to answer the questions. The researchers felt the survey was inadequate. There was a fair amount of observed tension and nervousness among the students before the intervention. As the intervention progressed, it was observed that the math anxiety of the students declined. The students seemed more enthusiastic about math when the lessons were presented with literature. The intervention lessened math anxiety.

The researchers saw a change in their own questioning patterns which helped to lessen the anxiety of the students. The students felt more comfortable with verbalizing their understanding of different ways of solving the same problem. They felt less threatened or anxious with an incorrect answer. A mistake was not just a mistake but sometimes a pathway to finding the answer. This is just as important as the answer itself.

Family Math Bags

The parent comment sheets in the Family Math Bag indicated that, on the whole, parents were enthusiastic about the real-life problem solving activities. One comment was, "We did not realize there were so many activities that involved math in the home." The children and parents enjoyed the Riddles and Magic Puzzles which both include problem solving. The activities that involved the entire family, such as the 'Guess and Check', were among the favorite activities. A small percentage of the parents did not understand the purpose of tying in real-life activities with the Family Math Bag. Comments recieved were, "Please include flash card activities." and "Math worksheets would be nice." The Family Math Bag seemed to be a successful intervention relating problem-solving in real-life situations.

Parent Involvement Letters

The parent involvement letters resulted in very little feed back. Comments received include:

- The activities were helpful for all the children in our family.
- We were able to use the ideas for our preschooler as well as our children in higher grades.
- You need more challenging ideas for our gifted child to use at home.

Parents seemed to have trouble extending the ideas they had received and springboarding them into other areas.

The researchers used the artifacts of the activities as authentic assessment. The collection of artifacts is

evidence of strategies practiced. In one activity the students were asked to tell how many bandaids they put on the figure and how they went about solving the problem. There were a variety of authentic answers within their journaling.

Conclusions and Recommendations

Based on the presentation and analysis of the data on increasing the student's ability to problem-solve in real-world situations and decreasing their anxieties toward mathematics, the students showed a marked improvement in both areas. In the beginning of the implementation the students didn't think they were doing math unless the math book was out. If a math and literature lesson was presented during the normal math period, the students wanted to know when they were going to do math. Later on, in the implementation, they acknowledged that they were going to do 'fun math'. This is a sign that math anxiety had decreased. The students began relating times they used math at home or during play. While doing routine activities in class or reading a story, the students pointed out the use of math.

The researchers would like to suggest a modification of the implementation plan. They taught two lessons a week for the implementation period. Mandating two math and literature assignments a week is unrealistic. The planning time was too extensive and sometimes costly, depending on the supplies required. There cannot be a set number of lessons during a certain period of time. The lessons did not always fit in with the math being introduced. Sometimes the literature seemed forced into fitting a specific math concept. At other

times the literature and math concepts flowed beautifully. The researchers have concluded that mandating math and literature lessons to a schedule is not advisable. There may, at times be three lessons a week and other times none at all. Occasionally, a math and literature lesson may be added just for fun.

Math and literature should not be the only intervention in a math program. Literature is only one approach to use. There are other wonderful ideas and materials produced to decrease math anxiety and increase the use of math in real-life problem-solving. These include math games, computer programs, math centers, math manipulatives and math centered real-life units. Just recently, sections of primary book order clubs are devoted to books centered around math concepts and activities.

At times it was difficult finding the proper book to fit a concept. As we went further into the implementation, we became amazed at the amount of materials available for math and literature. Reading Rainbow Videos have developed a Math and Reading Rainbow series. Our school has ordered some with our recommendation. There is an easy-reader book series by Scholastic that is devoted to math concepts with reading level steps. Each book has suggested questions and activities. Entire publications are available, listing titles of books that would be good leads for special math concepts.

As the implementation time progressed we discovered that we grew in our ability to pick the proper books for our math program. We started out using many predeveloped lessons. As time passed, we began to design our own.

The researchers went into this project hoping that somehow we could make a difference in the way the children viewed mathematics. We wanted them to realize that math is all around them every day and they should value and understand that. The researchers feel the project was a success and more. We are more aware of new strategies to help our students and the new materials available to foster those strategies. Even if the intervention had not turned out the way we hoped, just the joy of sharing good literature with the students would have been reward enough.

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APPENDIX A

SURVEYS

54

Teacher Math Survey On Anxiety

Administered Orally / Using Tally Marks

1. If you had your choice, when would you prefer to teach math?	Morning	Afternoon
2. Do you feel you have math anxiety?	Yes	No
3. Have you ever had students with math anxiety?	Yes	No
4. Do you think math anxiety could be a contributer to low math achievement in some students?	Yes	No
5. Do you know what NCTM stands for?	Yes	No
6. Have you ever read the NCTM Curriculum and Evaluation Standards?	Yes	No

Parent Survey About Math

Students Name_____

Mother's (Female Guardian) Survey

1. Does your child like math?

2. What does your child like in math? (examples)

3. What doesn't your child like in math? (examples)

4. How is flash card time experience in your house?

Great Good Time O.K. Bad Time Nightmare

5. What were your feelings about math when you were in school?

Parent Survey About Math

Students Name_____

Father's (Male Guardian) Survey

1. Does your child like math?

2. What does your child like in math? (examples)

3. What doesn't your child like in math? (examples)

4. How is flash card time experience in your house?

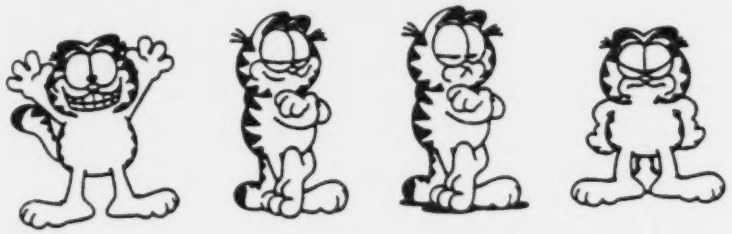
Great Good Time O.K. Bad Time Nightmare

5. What were your feelings about math when you were in school?

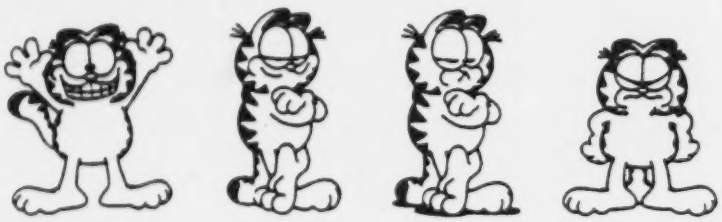
Name_____ Grade_____

Elementary Math Attitude Survey

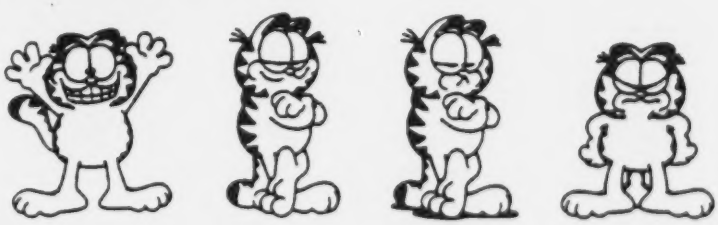
1. How do you feel about math in school?



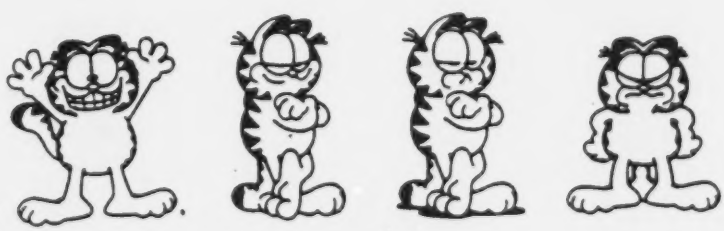
2. How do you feel about playing math games in school during free time?



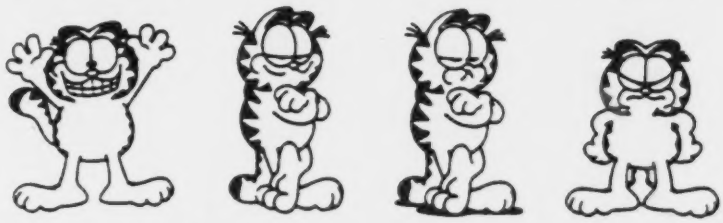
3. How do you feel when the teacher asks you questions about a math lesson?



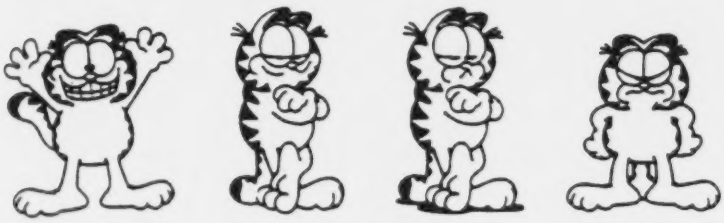
4. How do you feel about doing math workbook pages and worksheets?



5. How do you feel when it's time for math class?



6. How do you feel about learning new things about math?



7. Do you think math is easy or hard?

Easy Hard

8. Circle the things you like in math.

addition math facts

skip counting

counting money

ordinal numbers

story problems

shapes

graphing

subtraction math facts

telling time

measuring

fact families

place value

fractions

estimating

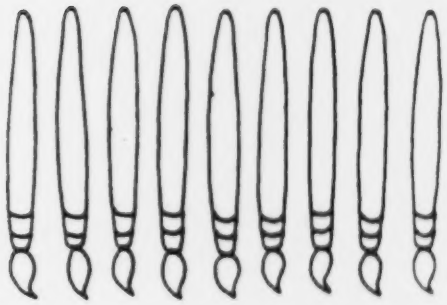
APPENDIX B

MATH SKILL SURVEY

MATH SKILLS SURVEY

Read each question. Find the answer.

1. How many are there?



_____

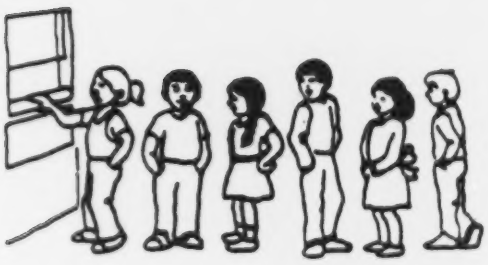
2. Ring the group of numbers that is in the correct order.

7, 8, 9

8, 7, 9

5, 7, 6

3. Ring the child who is third in line.



4. Write the missing number.

78, 79, 80, _____, 82

5. Count by fives. Write the missing number.

80, 85, _____, 95

6. Count by twos. Write the missing number.

56, 58, 60, _____, 64

Go on to the next page.

MATH SKILLS SURVEY

7. How many in all?

5 + 1 = ____

8. 3 .

3 .

How many in all?

____

9. Add.

$$\begin{array}{r} 4 \\ +2 \\ \hline \end{array}$$

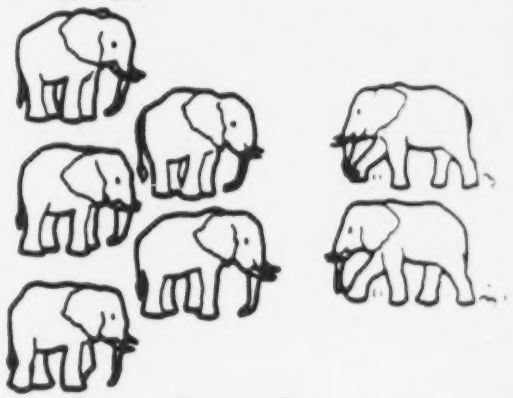
10. Add.

6 + 2 = ____

11. Add.

8 + 0 = ____

12. Ring the number sentence that tells how many in all.



5 − 2 = 3

7 − 2 = 5

5 + 2 = 7

Go on to the next page.

13. Add.

$$\begin{array}{r} 5 \\ +4 \\ \hline \end{array}$$

14. Add.

$7 + 1 = ____$

15. Add.

$9 + 3 = ____$

16. Add.

$$\begin{array}{r} 7 \\ +4 \\ \hline \end{array}$$

17. Add.

$$\begin{array}{r} 5 \\ 3 \\ +2 \\ \hline \end{array}$$

18. Add.

$$\begin{array}{r} 2 \\ 2 \\ +8 \\ \hline \end{array}$$

19. Add.

$$\begin{array}{r} 36 \\ +42 \\ \hline \end{array}$$

20. Add.

$$\begin{array}{r} 25 \\ +64 \\ \hline \end{array}$$

Go on to the next page.

21. Add.

$$\begin{array}{r} 9 \\ +9 \\ \hline \end{array}$$

22. Add.

$7 + 8 =$ ____

23. Nicole has 35 cards. John gives her 14 more. How many does she have in all?

____

24. Ring the number sentence that belongs to the same family of facts as

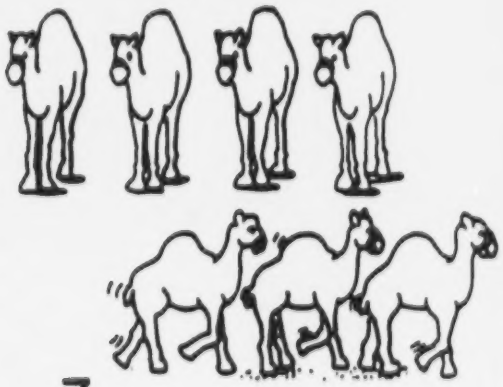
$15 - 6 = 9$

$9 - 6 = 3$

$9 + 6 = 15$

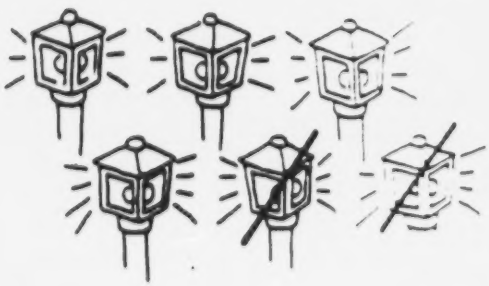
$9 - 3 = 6$

25. How many are left?



$$\begin{array}{r} 7 \\ -3 \\ \hline \end{array}$$

26. How many are left?



$6 - 2 =$ ____

Go on to the next page.

27. Subtract.

$$\begin{array}{r} 5 \\ -4 \\ \hline \end{array}$$

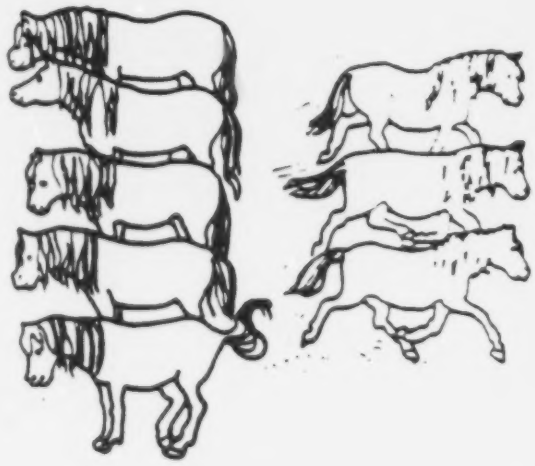
28. Subtract.

$6 - 6 = ____$

29. Subtract.

$8 - 1 = ____$

30. Ring the number sentence that tells how many are left.



$8 - 3 = 5$

$8 - 6 = 2$

$5 - 3 = 2$

31. Subtract.

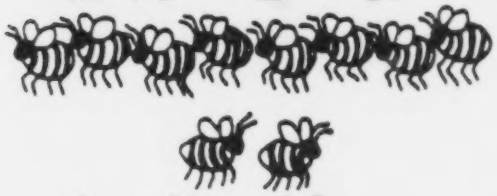
$$\begin{array}{r} 10 \\ -\ 3 \\ \hline \end{array}$$

32. Subtract.

$$\begin{array}{r} 9 \\ -0 \\ \hline \end{array}$$

Go on to the next page.

33. Ring the number sentence that belongs to the same family of facts as $10 - 2 = 8$.



$6 + 4 = 10$

$8 + 2 = 10$

$8 - 2 = 6$

34. Subtract.

$12 - 6 =$ ____

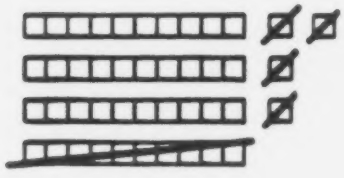
35. Subtract.

$11 - 8 =$ ____

36. Subtract.

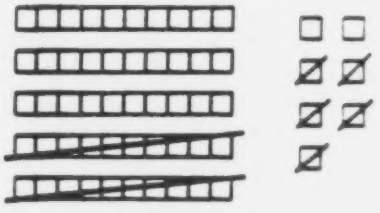
$12 - 4 =$ ____

37. Subtract.



$$\begin{array}{r} 44 \\ -\,14 \\ \hline \end{array}$$

38. Subtract.



$$\begin{array}{r} 57 \\ -\,25 \\ \hline \end{array}$$

Go on to the next page.

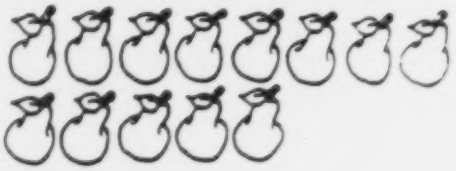
MATH SKILLS SURVEY

39. Jenny has 75 red chips. She gives her sister 25. How many does Jenny have left?

_____

40. Ring the number sentence that belongs to the same family of facts as

$8 + 5 = 13.$



$8 - 5 = 3$

$5 + 3 = 8$

$13 - 5 = 8$

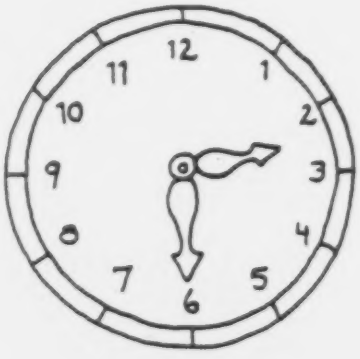
41. Subtract.

$16 - 8 =$ _____

42. Subtract.

$17 - 9 =$ _____

43. Ring the correct time.



1:30 2:30 6:30

44. How many cents are there?

_____ C

Go on to the next page.

MATH SKILLS SURVEY

45. Andy has .

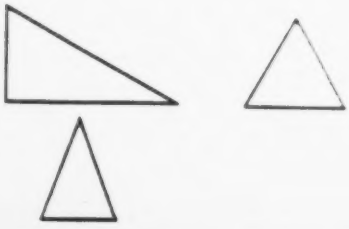
He buys

.

How many cents does he have left?

_____¢

46. Ring the one that is the same shape and size as .



47. Ring the fraction shown by this picture.

$\frac{1}{3}$ $\frac{1}{2}$ $\frac{1}{4}$

48. About how long is this crayon?

about _____ centimeters

49. About how long is this piece of ribbon?

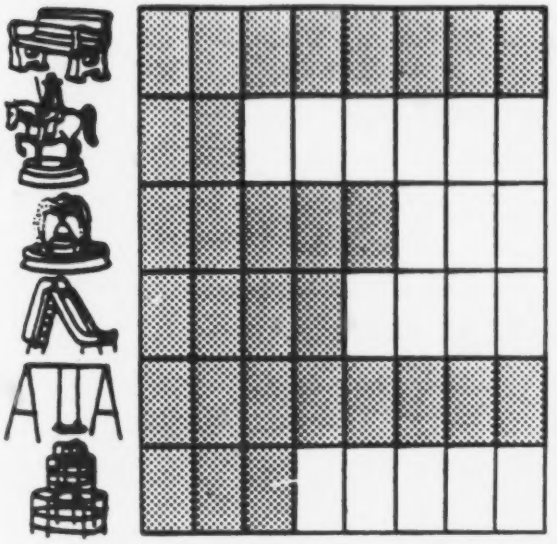
about _____ inches

50.

Ring the one that holds about the same as 1 liter.

Go on to the next page.

The children counted things in the park. Then they made a graph. Use it to answer questions 13 through 15.



51. Look at the graph.
How many are there?

_____

52. Look at the graph.
How many are there?

_____

53. Look at the graph.
How many are there?

_____

54. Write >, <, or =.

27 ◯ 77

55. Write >, <, or =.

53 ◯ 35

Stop!

APPENDIX C

PARENT INVOLVEMENT LETTERS

MATH NEWS LETTER NO. 1

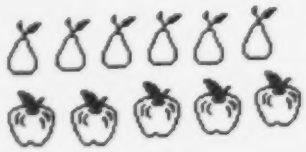
Dear Parents,

We know that all parents want their children to enjoy school and succeed with schoolwork. Most parents want to help children learn mathematics, but many are not sure how to proceed. We want to help parents, to help their children. We are including a few helpful suggestions that can be used by parents of preschool aged children as well as children of the elementary grades.

1. Show personal interest in children's activities that involve numbers and shapes. Do some of the activities with them. Let them know you are excited that they are learning about numbers and shapes.

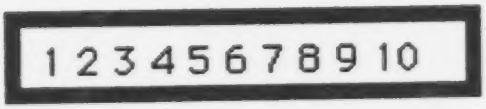
2. Introduce mathematics vocabulary to children while they are working with objects, pictures, and drawings.

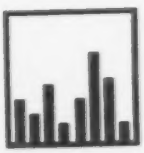
Example: Are there more apples or more pears? Lets count (or match them up one to one) to find out.



Example: That piece of puzzle is shaped like a square. Do you see another piece (or something else in the room) that looks like a square?

3. Whenever children count, measure, or collect other quantitative information, encourage them to make a record of what they find. They may wish to write numerals (numbers), make a simple graph or possibly drawings.



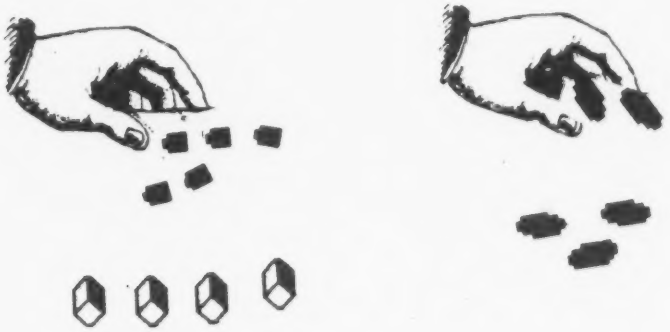


4. Play mathematics games with your children. One example of a mathematics game for young children is "How Many Did I Take?" Be sure to take turns.

How Many Did I Take?

The first player matches two sets of objects one-to-one and shows that both sets have the same number of objects. While the other player closes his eyes, the first player scrambles all the objects together, then removes some from one set. The other player finds how many were removed by pairing the sets again.

A variation of the game uses only one set of objects, possibly a set of seven marbles. The first player covers part of the set with his hand and has the other player tell how many are under the hand. The objects are then uncovered to see if the number given by the other player is correct.



We hope that some of these suggestions will be useful to you in working with your child at home.

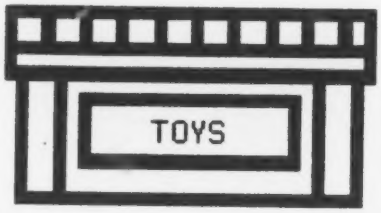
These suggestions were taken from an article published in Arithmetic Teacher, written by Robert B. Ashlock.

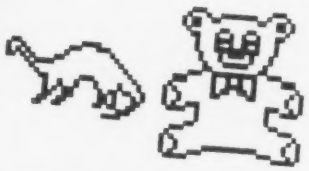
MATH NEWS LETTER NO. 2

Dear Parents,

Parents want their children to enjoy school and succeed with schoolwork. Most parents want to help children learn mathematics, but many are not sure how to proceed. We want to help parents, to help their children. We are including a few more helpful suggestions that can be used by parents of preschool aged children as well as children of the elementary grades.

At The Toy Box





Preschool and Kindergarten

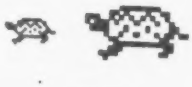
* Count toys while putting them away, and then say, "We put away (_3_) toys." This is just an example to give you some ideas.

* Sort toys into sets: cars, blocks, dolls, and so on. Prepare three-inch by five-inch cards with numerals (numbers) on them and have the child choose a card for each set to show how many items are included. A zero card can be used to show there are no toys of a certain kind.

Grades 1 to 3

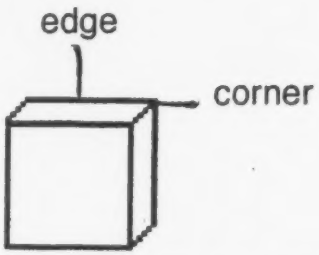
* Find shapes indicated on toys: squares, circles, rectangles, and triangles. Help the child trace each shape with a finger. They then may wish to draw that shape on a piece of paper.

* Ask these questions: Which is larger? Which is largest? Which is smaller? Which is smallest?

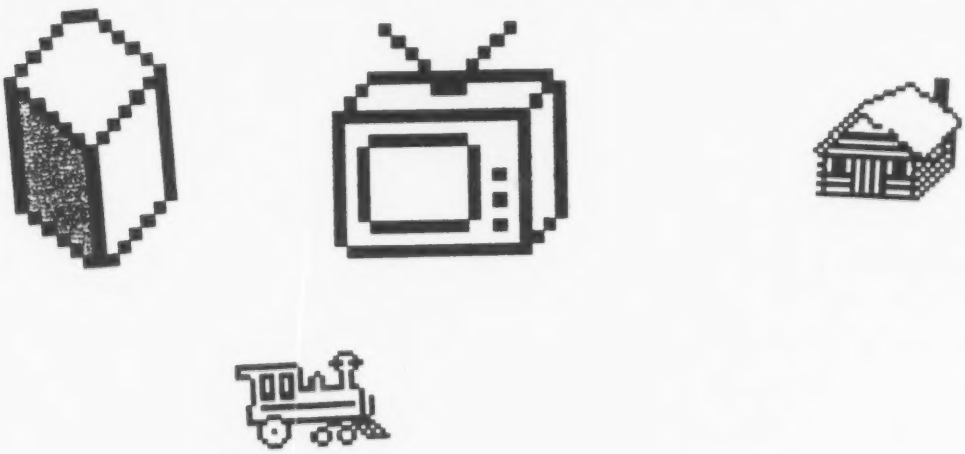


* Are there more horses or more riders? Are there fewer horses or riders? Match horses and riders one-to-one.

* How many corners are on this block? How many edges?



* Which blocks are shaped like this one? On blocks and other toys feel and describe flat surfaces, curved surfaces, edges, and corners.



These suggestions were taken from an article published in Arithmetic Teacher, written by Robert B. Ashlock.

MATH NEWS LETTER NO. 3

These suggestions were taken from an article published in Arithmetic Teacher written by Robert B. Ashlock.

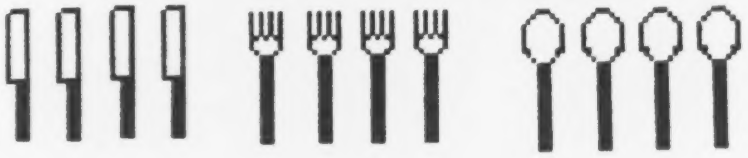
Dear Parents,

We are including a few helpful suggestions that can be used by parents of preschool aged children as well as children of the elementary grades to help their child at home.

In The Kitchen and the Dining Room

Preschool and Kindergarten

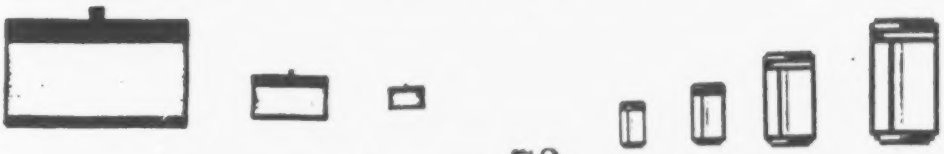
* Sort silverware into sets of knives, forks, and spoons.



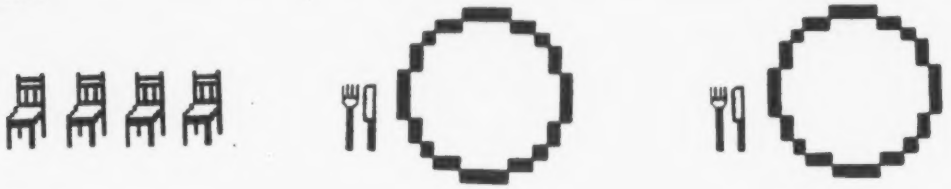
* Place a paper napkin at the left of each plate. Fold napkins as rectangles one day, then as triangles the next.

* Compare pots and other containers in the kitchen. Ask, "Which hold the most? Which holds the least?"

* Order pots by size. Order cans by diameter.

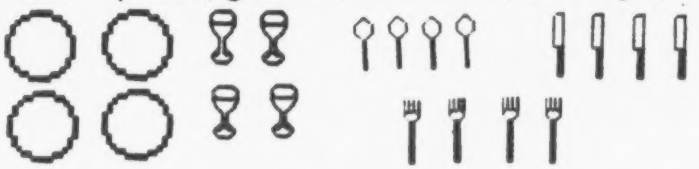


* Find the number of chairs needed to match places set at the dining table.



Grades 1 to 3

* Count the number of plates, glasses, and so on, to carry to the dining table.



* Count beans or anything like beans, popcorn, etc.. Ask, "How many beans (or what ever you have used) are in the bowl?"

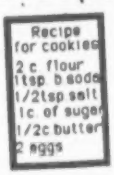
* Find how many juice cans of water it takes to fill a pot or bowl.

Grades 4 to 6

* Compute how much of an item is needed to prepare for a meal, given the amount for each person.

1 Person	If 4 people are eating, how much food?
1 potato 4oz. meat 1c. veg.	

* Compute the amount needed if a recipe is doubled, tripled, or halved.



MATH NEWS LETTER NO. 4

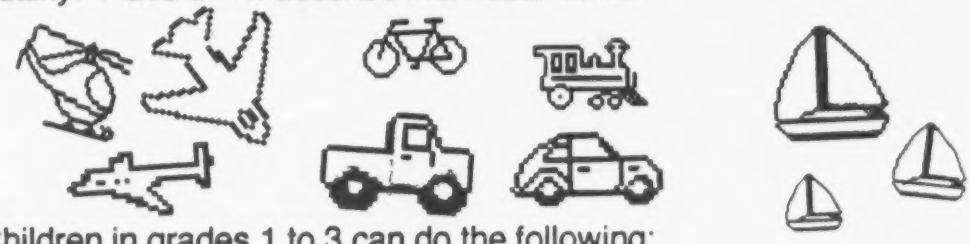
Dear Parents,

Here are a few helpful suggestions that can be used by parents of preschool aged children as well as children of the elementary grades to help further your child's education in the area of mathematics.

Around the House

Children can do many things around the house that involve mathematics. Preschool children can do the following:

Sort one kind of item (socks, toys, etc.) by size, color, or other quality. Have them describe individual items.



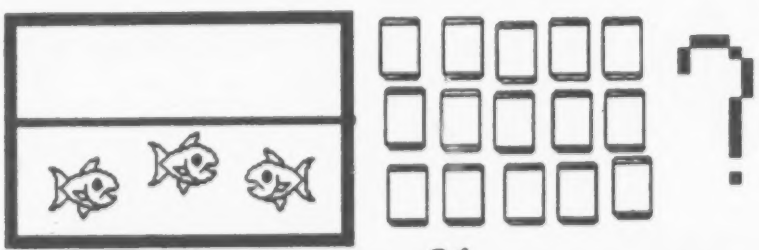
Children in grades 1 to 3 can do the following:

Count on a calendar. Ask, "How many days (weeks, months) until .....?"

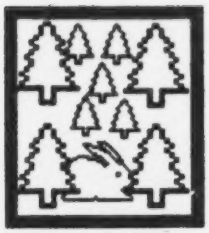
MARCH

	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

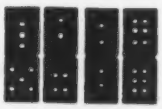
Count the number of containers of water it takes to fill the aquarium.

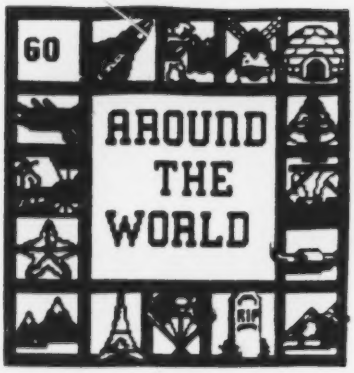


Make decorations from cutout shapes.



Play games that involve counting: games with dice, dominoes, and board games.

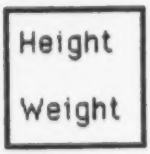


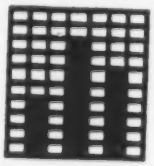


Find specific pages in the book before story time.

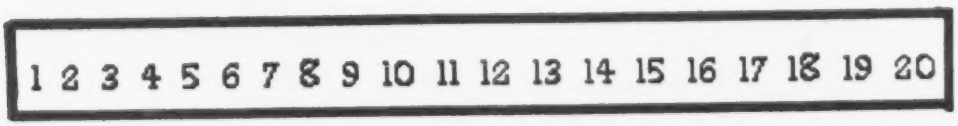
Estimate, then count the number of people in a room.

Keep records of weight and height; make a graph and keep it current.
Find differences from time to time.





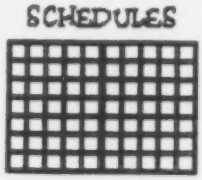
Measure things around the house and record the observed measurements.
Use metric whenever possible.



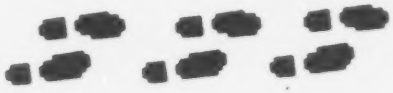
Play store, or really sell some product (lemonade, radishes from the garden, etc.). Make change, pay overhead, and calculate profit or loss.

Children in grades 4 to 6 can do the following:

Read schedules for information: the television guide; and bus, train, or plane schedules.

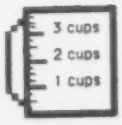


Estimate the length, width, and area of a room or stair steps by pacing it off.



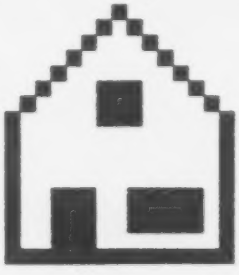
Draw objects they see rather than copy drawings from a book. Give attention to proportion.

Measure amounts for cooking.



Estimate the amount of paint needed for painting a certain area.

Build something from a craft book.



These suggestions were taken from an article published in Arithmetic Teacher written by Robert B. Ashlock.

MATH NEWS LETTER NO. 5

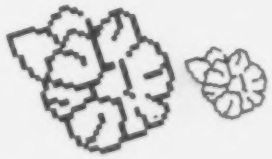
Dear Parents,

Here are a few helpful suggestions that can be used by parents of preschool aged children as well as children of the elementary grades to help further your child's education in the area of mathematics.

In the Garden

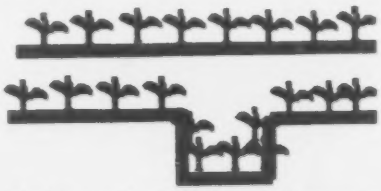
Preschool children can do the following:

Compare flowers. Ask, "Which flower is the largest? Which is smallest?"



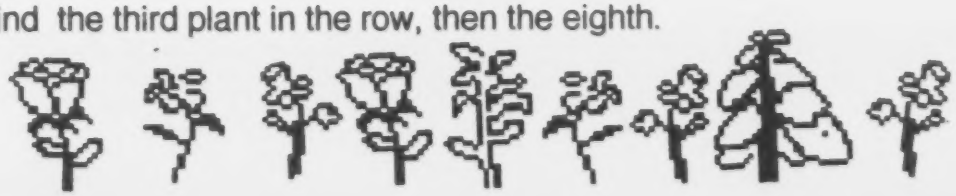
Children in grades 1 to 3 can do the following:

Compare different paths. Ask, "Which path is longer? Which is shorter?"

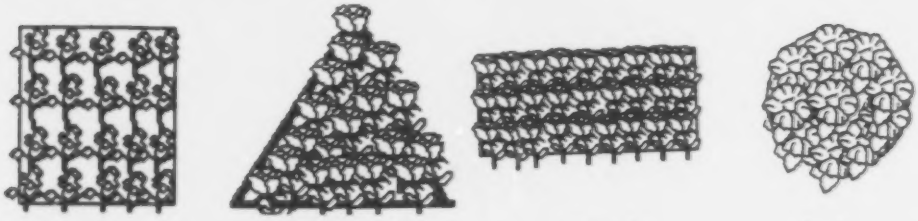


Count the number of petals on individual flowers. Ask, " Do all tulips have the same number of petals? Which kind of flower has the greatest number of petals?

Find the third plant in the row, then the eighth.



Use names of shapes to describe beds of plants.



square triangle rectangle circle

Children in grades 4 to 6 can do the following:

Find parallel rows of plants.

not parallel parallel

Keep records of the number of seeds planted, the number of vegetables harvested, then compare ratios for different kinds of vegetables.

These suggestions were taken from an article published in Arithmetic Teacher, written by Robert B. Ashlock.

MATH NEWS LETTER NO. 6

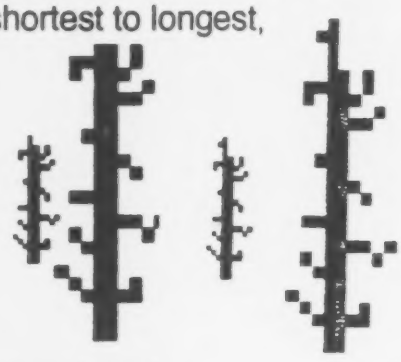
Dear Parents,

Here are a few helpful suggestions that can be used by parents of preschool aged children as well as children of the elementary grades to help further your child's education in the area of mathematics.

In the Yard or at the Playground

Mathematics activities should involve what children see and touch around them. Preschool children can do the following :

* Line up sticks by length "like stair steps" from shortest to longest, then longest to shortest.



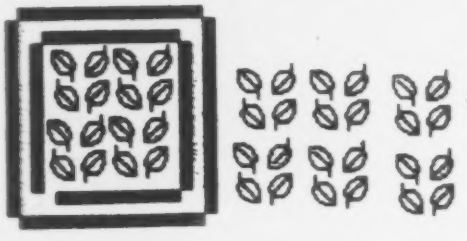
Children in grades 1 to 3 can do the following:

* Count by twos, fives, and tens when playing hide-and-seek.

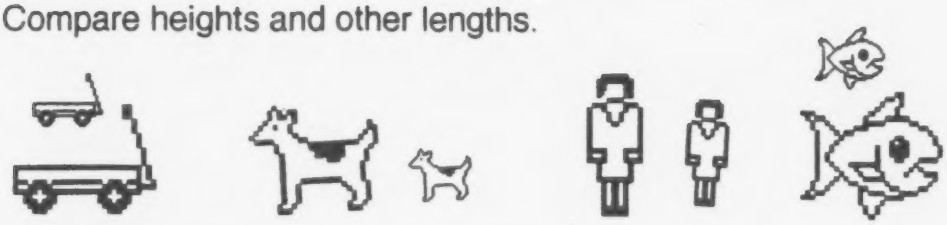
2,4,6,8,.... 5,10,15,20..... 10,20,30,40.....

* Estimate and count pebbles. Ask, "How many pebbles are in a handful?"

* Estimate and count leaves. Ask, "How many leaves can we put in this box?"



* Compare heights and other lengths.



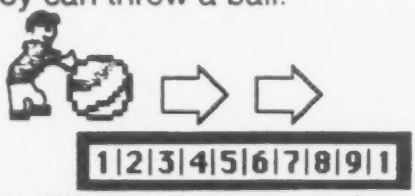
* Count jumps when jumping with a rope.

1 , 2 , 3 , 4 , 5 , ...

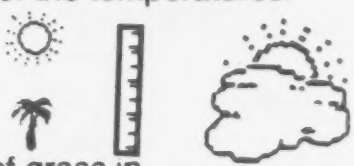
* Count the number of times they are able to bounce the ball without stopping.

Children in grades 4 to 6 can do the following:

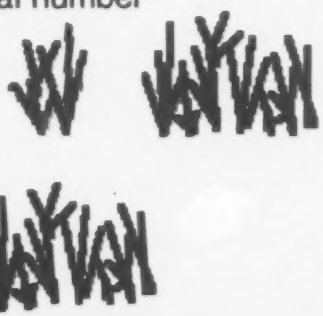
* Measure the distance they can throw a ball.



* Compare temperatures at different times, or at the same time each day. Make a graph of the temperatures.



* Estimate the total number of blades of grass in a square foot. Count the blades of grass in a square inch and do some scattered samples in the square foot. Last of all, multiply your findings in your samples with the total number of square inches in the square foot.



Suggestions were taken from an article published in Arithmetic Teacher, written by Robert B. Ashlock.

MATH NEWS LETTER NO. 7

Dear Parents,

Parents can help young children learn mathematics. They can help children see numbers and shapes in the world around them. They can help children understand the importance and usefulness of mathematics. Here are more helpful suggestions that can be used by parents of preschool aged children as well as children of the elementary grades to help further your child's education in the area of mathematics.

In the Car

Many activities involve mathematics that children can do while riding in a car. Preschool children can do the following:

* Name places they have already seen during the ride and name these places in the order they were seen.

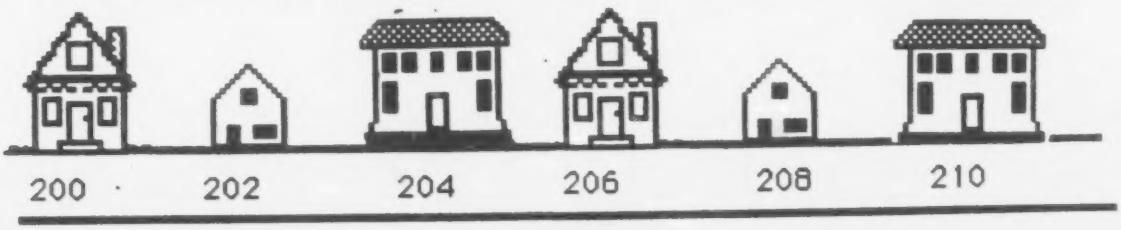
Children in grades 1-3 can do the following:

* Count forward to a designated number, or count backward.

1,2,3,4,5,6,7,8,9,10 **10,9,8,7,6,5,4,3,2,1**

* Count from 0 to 9 using digits (numbers) seen on license plates.

* Look at house numbers on one side of the street and count by twos.



* Read posted route numbers. Find the greatest and the smallest number.

* Read license plate numbers.

* Add all the digits on license plates and record the sum. Find as great a sum as possible.

* Read number of miles to your destination as posted, check the odometer, and occasionally determine the remaining distance.

Odometer	Miles to Madison	Odometer	120 Miles to go
72,526	220	72,626	

Children in grades 4 to 6 can do the following:

* Play "buzz." All players count together by ones, but they say buzz for each multiple of a designated number and for each numeral that contains the designated number.

For example, if the number is 3, the count would be the following:
1, 2, buzz, 4, 5, buzz, 7, 8, buzz, 10, 11, buzz, buzz, 14, ...

* Add points for the things the children see. Have each of two children take a side of the car. In one game children collect points for different animals they see: birds count 1 point each; dogs, cows, and cats are 5 points each; horses, 10 points; a cat in a window is 100 points. In the city, assign point values to different kinds of signs.

* Compute mileage for a trip. Estimate before hand from a highway map. Also estimate the amount of fuel needed.

These suggestions were taken from an article published in Arithmetic Teacher, written by Robert B. Ashlock.

MATH NEWS LETTER NO. 8

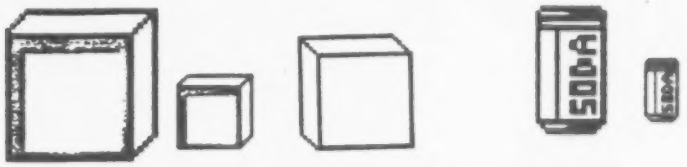
Dear Parents,

Parents can help young children learn mathematics. They can help children see numbers and shapes in the world around them. They can help children understand the importance and usefulness of mathematics. Here are more helpful suggestions that can be used by parents of preschool aged children as well as children of the elementary grades to help further your child's education in the area of mathematics.

At a Store or a Restaurant

Preschool children can do the following:

* Compare boxes or cans. Ask, "Which box is larger? Which is smaller?"



Children in grades 1 to 3 can do the following:

* Determine the amount saved from buying things on sale.

$22.50
On sale for $18.50

* Select an item to buy and save for it. Ask, " How much money do you have now? How much more do you need to save? How long will it take if you save (you determine how much) each week?"

I have $4.50.
I still need _____.
My allowance is _____.
It will take me ___
weeks to save enough money
to buy the Teddy Bear.

* Pay for items bought and show that the change is correct.

Wagon costs $25.95.

You gave them $26.00.
How much should you get back?

Children in grades 4 to 6 can do the following:

* Compare prices and quantities for different brands. Determine which costs less per unit of measure.

Honey's Bakery $15.00

Sunshine Bakery $14.85

Apples

5 pounds at $.50 a pound.

or

$.30 each

* Estimate the total amount that will appear on the bill.

grapes for $.35

cheese for $1.25

an apple for $.25

cake for $5.50

These suggestions were taken from an article published in Arithmetic Teacher, written by Robert B. Ashlock.

MATH NEWS LETTER NO. 9

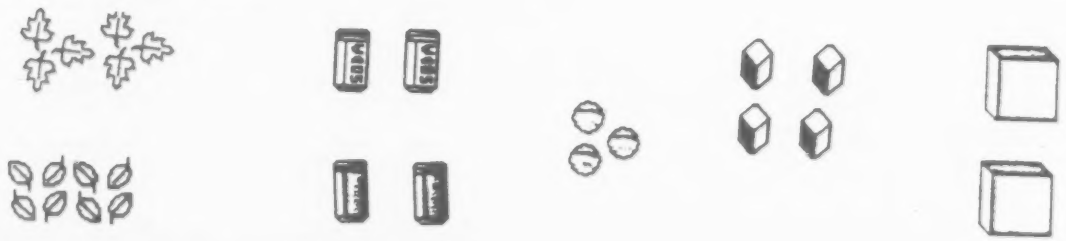
Dear Parents,

Parents can help young children learn mathematics. They can help children see number and shape in the world around them. They can help children understand the importance and usefulness of mathematics. Here are a few helpful suggestions that can be used by parents of preschool aged children as well as children of the elementary grades to help further your child's education in the area of mathematics.

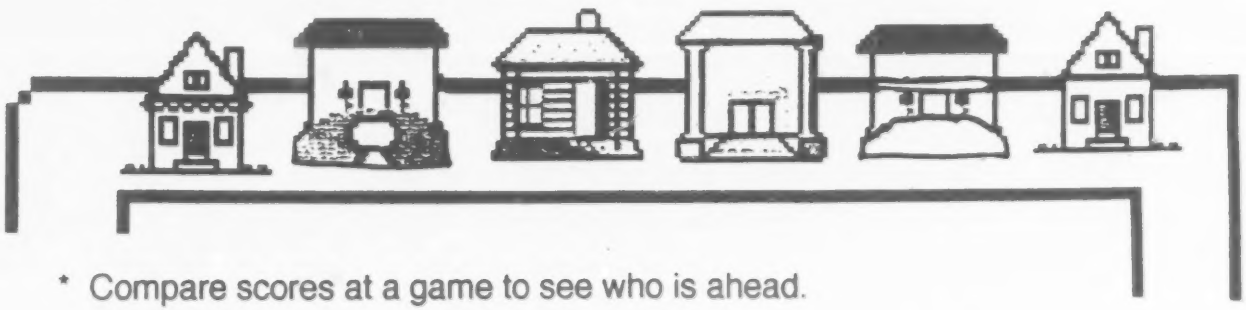
In the Neighborhood and Beyond

Preschool children can do the following:

* Classify such objects as pebbles, acorns, shells, and leaves. Classify different types or different colors, or use such categories as shiny and dull.



* Find the second house from the corner, then the fourth.



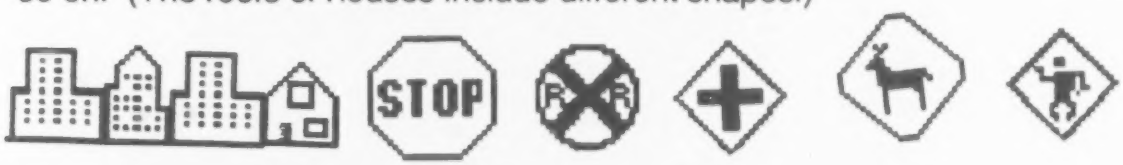
* Compare scores at a game to see who is ahead.

Score is
26 to 20

* Keep score in a game. Add or subtract as needed.

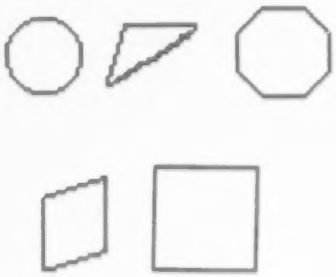
* Look for one or more of the following signs while taking a walk. Be sure to take special note of signs, buildings, and other construction projects.

-Triangles, squares and other rectangles, hexagons, octagons, and so on. (The roofs of houses include different shapes.)



- Different quadrilaterals; rectangles, parallelograms, trapezoids, rhombuses, and so on.

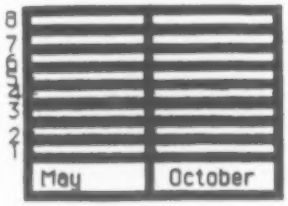
- Parallel lines -



* Inventory different kinds of pets in the neighborhood, and make a bar graph to show the number of each kind.

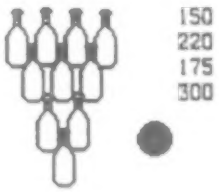
* Make a list of the birthdays of family and friends and then put the dates in sequence. Make a bar graph to show the number of birthdays each month.

May 10	October 3
May 12	October 5
May 14	October 7
May 29	October 29
May 31	

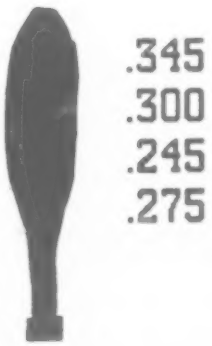


* Open a savings account, and keep track of interest earned and the balance.

* Keep bowling scores and find averages.



* Compute batting averages of baseball players.



These suggestions were taken from an article published in Arithmetic Teacher, written by Robert B. Ashlock.

APPENDIX D

FAMILY MATH BAG

Dear Families,

It is your turn to have the Math Magic bag. I hope you are ready for lots of fun and learning.

The back pack contains several different mathematics activities. Each one includes directions and the necessary materials.

These activities are meant to be done in a family setting. Sisters, brothers, grandmothers, grandfathers, aunts, uncles, moms, and dads should be included.

The purpose of these activities is to help children acquire a better understanding of some mathematics concepts and enjoy working with their family.

THE ACTIVITIES WILL BE MUCH MORE BENEFICIAL TO THE CHILDREN IF DISCUSSION ABOUT THE ACTIVITIES OCCURS WHILE THE ACTIVITIES ARE TAKING PLACE. DOING ONE ACTIVITY WITH GOOD MATHEMATICAL DISCUSSION IS BETTER THAN DOING FIVE ACTIVITIES WITHOUT DISCUSSION!

Please check the inventory list to make sure that all materials that arrive at your house are in the bag when you return it to school. If you misplace or lose any items, please write a note so the item can be replaced, if possible. Please take care or the bag and treat it with respect so everyone can enjoy it!

Please return the bag to school within three to four days with comments written in the mathematics log.

Enjoy!

A special note: The second grade teachers would like to thank their colleagues, Ms. Bendery and Ms. Bjelopetrovich for designing the Family Math Bag and sharing it with us.

Family Math Bag Inventory

1 Three-ring notebook
1 Box of 8 large Crayola Crayons
1 Box of 12 Crayola colored pencils
1 Large envelope - "Guess and Check"
5 Zip-lock baggies containing:

"Number Magic"

1. Guess and Check - Students guess and then check to see how many windows, doors, beds, etc. are in their home.
2. Magic I Puzzle - Includes directions.
3. Magic Square Puzzle- Includes direction.
4. Magic C Puzzle - Includes directions.
5. Magic T Puzzle - Includes directions.

Money (play money)

Contains 5 One-dollar bills
1 Five-dollar bills
3 Quarters
3 Dimes
3 Nickels
5 Pennies

Math Strategies

Contains yellow strategy pages, a number line and 20 counters.

"Riddle"

Contains paper bag and 10 unifix cubes

Origami

Contains Origami book and papers

This bag is valued at $27.60.

Riddle!

Take out the plastic bag marked "Riddle." Take out the paper bag BUT do not look inside the bag until you have solved the riddle. Here is the riddle:

This riddle is made up of clues. After reading each clue, think about what could be in the paper bag. Hint: There are unifix cubes in the bag. The cubes are red, blue, yellow, or green. Onto the clues.....

1. There are 10 cubes in the bag.
2. There are three colors.
3. There are three blue cubes.
4. There are two more red cubes than blue cubes.
5. There are three more red cubes than yellow cubes.

How many of each color cube are in the bag?

Riddle!

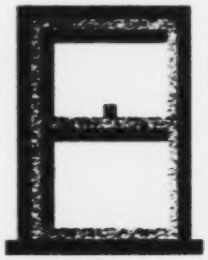
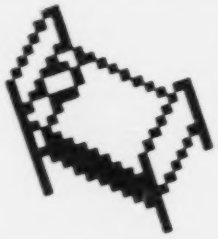
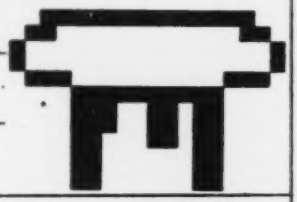
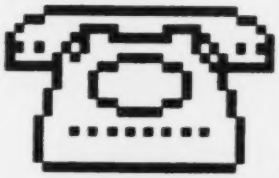
Solution!

In the bag there are:

3 blue cubes
5 red cubes
2 yellow cubes

Counting Fun

Look at the items below. How many of each do you have in your home? First, write your guess. Then take your paper and check around your home. Count the items to check your guess.

How many windows? Guess_____ Check_____ 	How many beds? Guess_____ Check_____ 
How many doors? Guess_____ Check_____	How many tables? Guess_____ Check_____ 
How many telephones? Guess_____ Check_____ 	How many chairs? Guess_____ Check_____
How many lamps? Guess_____ Check_____	How many clocks? Guess_____ Check_____

Taken from Frank Schaffer's **Schooldays**, Sept. / Oct. 1994

Math Strategies

Counting On:

To add by mentally counting on.

2
+6 Circle the greater addend and count on
8 with the other addend. 6 , 7 , 8

Doubles

4 + 4 = 8 "spider" fact

5 + 5 = 10 "fingers" fact

6 + 6 = 12 "dozen eggs" fact

7 + 7 = 14 "two-week" fact

8 + 8 = 16 "crayon" fact

9 + 9 = 18 "double-nine" domino fact

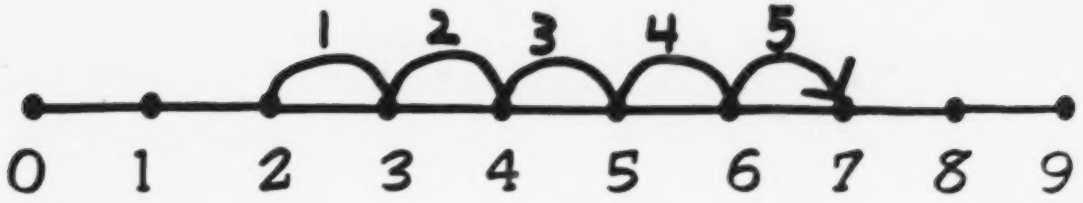
Doubles Plus One

8 + 9 (8 + 8 + 1)

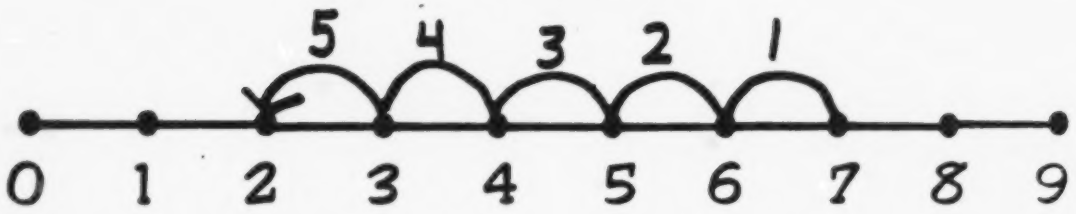
6 + 7 (6 + 6 + 1)

Number line

$2 + 5 = \square$



$7 - 5 = \square$



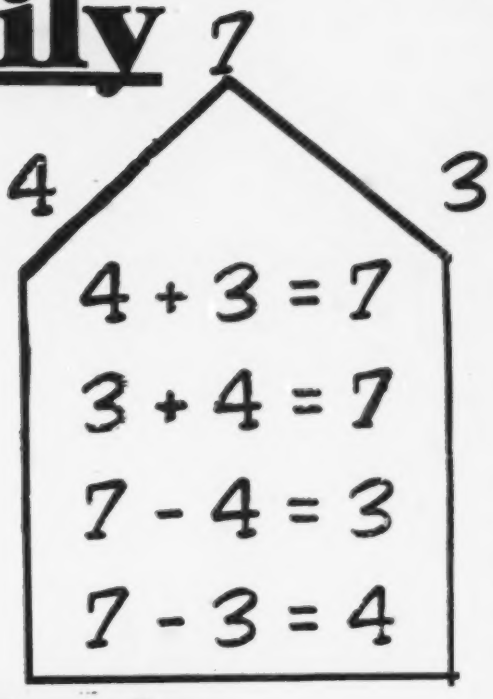
Count Up Facts:

Count up from the smallest number. (Subtraction)

$$\begin{array}{r} 11 \\ -\ 5 \\ \hline 6 \end{array} \ldots \text{(6, 7, 8, 9, 10, 11)}$$

Fact Family

Two addition
and
Two subtraction
sentences



Turn-around Facts

3 + 4 = 7 4 + 3 = 7

6 + 8 = 14 8 + 6 = 14

Related Subtraction Facts

7 - 3 = 4 7 - 4 = 3

14 - 6 = 8 14 - 8 = 6

MONEY!

Four children were walking to school. On the way, they found a five-dollar bill. When they got to school, they told their teacher. She said that the principal would probably be the person who would find out who lost it. The children told the principal and gave her the five-dollar bill. A week later, however, the principal called the four children into her office and told them that no one had claimed the money. "It's yours," she said, "but you'll have to share it equally among the four of you."

How much money did each child get?

MONEY SOLUTION!

Each child will recieve $1.25.

Window Graphing

Sit with someone and look out the window for 10 minutes. Graph how many of the following things pass by your window: car, truck, person, bike, and animal. Please use the piece of graph paper following this page. Return the completed piece of graph paper back to the spot you took it from. When everyone has completed this activity, we will discuss it in class.

Discuss the following questions with the person sitting with you.

1. Why do you think you saw more of some?

2. Do you think your graph would look different in a different season? Why?

For Fun! Sit at a different window or try this again later in the day and graph what you see? Are there any differences?

Window Graphing

Car								
Truck								
Person								
Bike								
Animal								

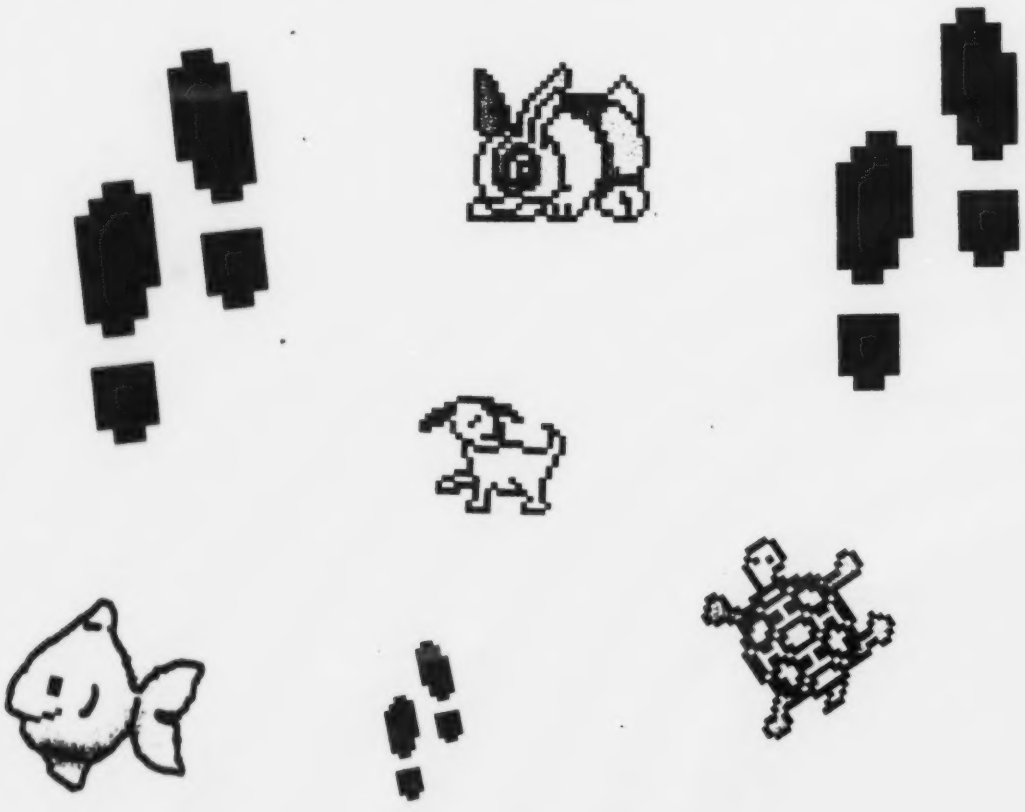
Name _____ **Time** _____

Date _____ **Season**_____

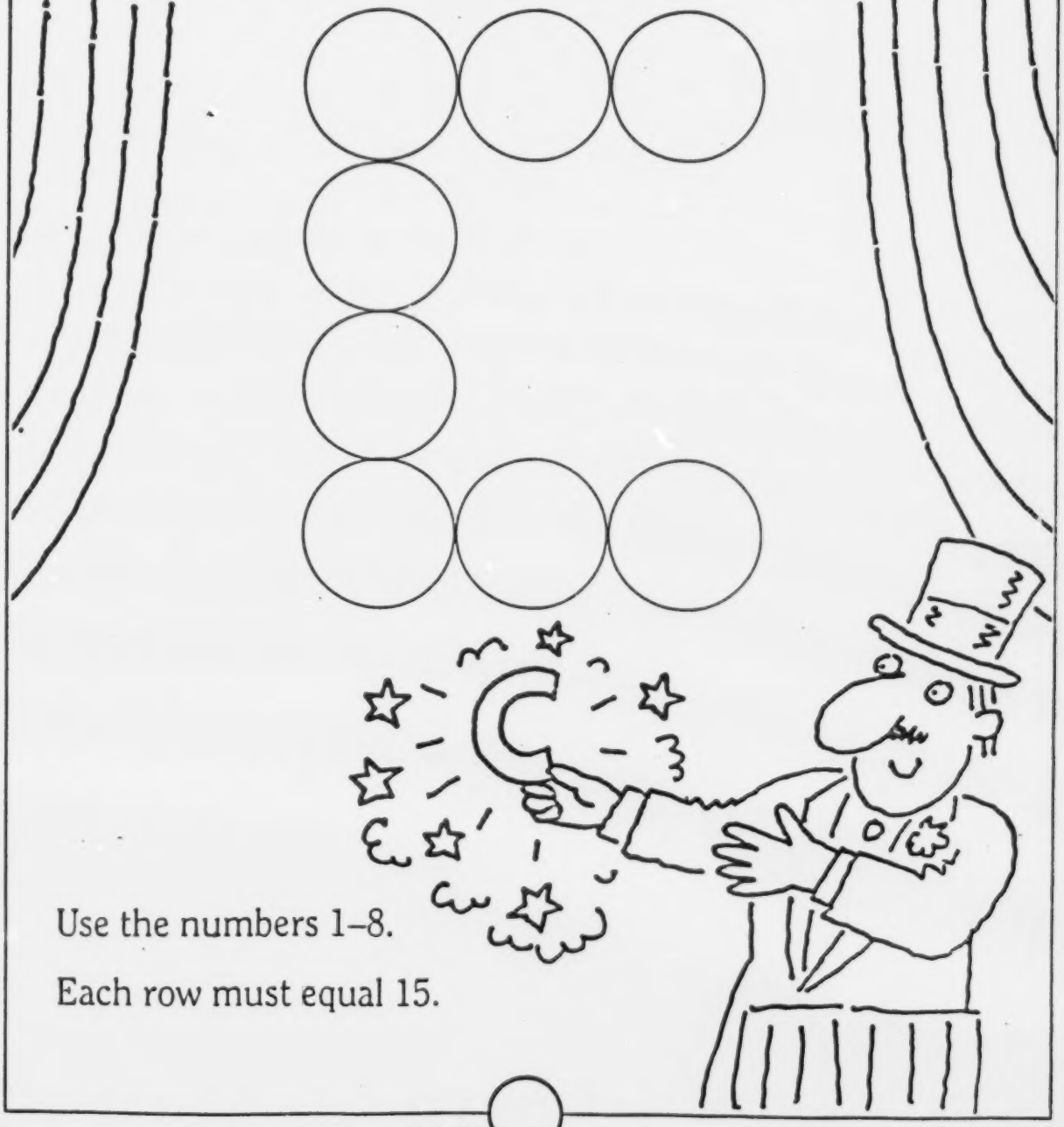
How many feet in your house?

PROBLEM: How many feet are there in your house? Please include pets.

Please record your answer on the graph at the back of the three ring binder. On the pages that follow, please explain how you found your answer.



MAGIC C

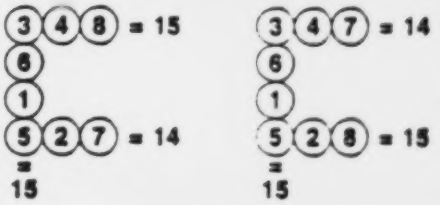


Use the numbers 1–8.

Each row must equal 15.

Notes on the Magic C

The Magic C is the first puzzle in which no hint is given. Children are inclined to work one row at a time and then start all over if the last row doesn't add up to 15. Some children will attempt to fix the incorrect row.



Recognizing that the bottom horizontal row needs one more, students may exchange the 7 in the row with the 8 in the top row. This does, indeed, fix the bottom row but now the top row is one short.

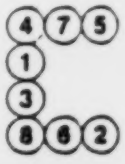
Other children will recognize that there are two key points in this puzzle—the points where the horizontal rows intersect with the vertical row. A number placed at one of these intersecting points can be exchanged with a nonintersecting number in the vertical row without harming a correct line.

In the first illustration, for example, if the 5 and the 6 are exchanged, the vertical row remains the same, while the bottom horizontal row now adds up to 15.

One correct solution for a sum of 15 is:

There are also solutions for sums of 13 and 16:

Sum = 13



Sum = 16

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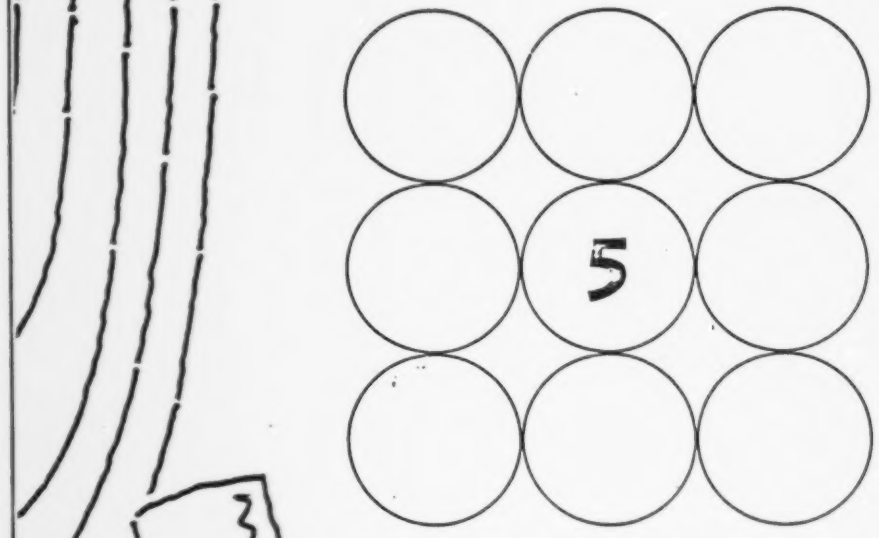
MAGIC SQUARE



Use the numbers 1–9.

Each row (horizontal, vertical, and diagonal) must add up to 15.

Notes on the Magic Square

The Magic Square is one of the most well known of the Magic Number puzzles. Your students may even have encountered this one before in mathematical game and puzzle books.

Again, the center number is provided as a hint. This time the numbers 1 through 9 are used and the magic sum is 15.

Most children will find this puzzle a bit more challenging but not difficult enough to be frustrating.

One solution is:

8	1	6
3	5	7
4	9	2

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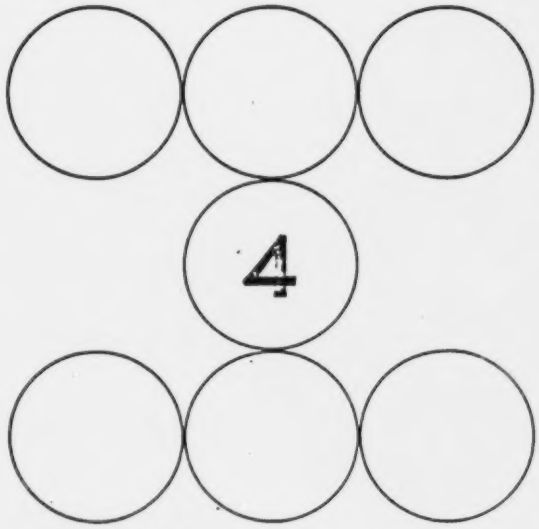
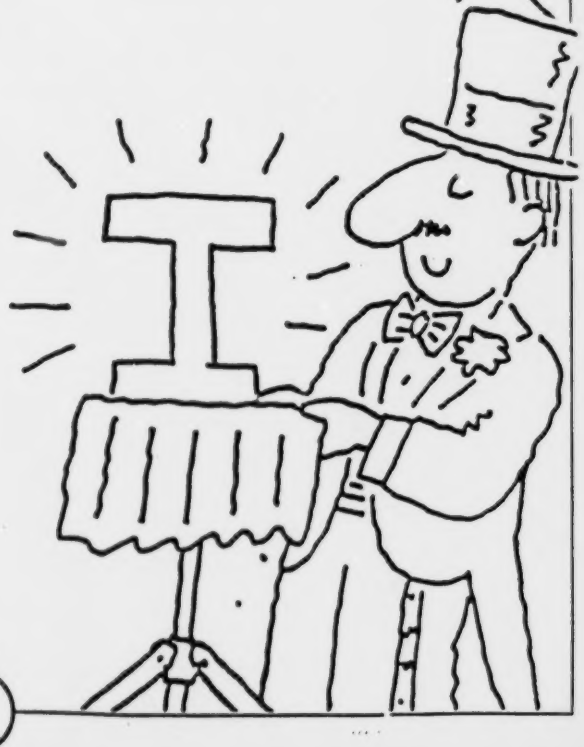
MAGIC 1





Use the numbers 1–7.

Each row (horizontal, vertical, and diagonal) must add up to 12.

Notes on the Magic I

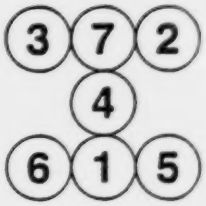
Most children will achieve quick success with this puzzle. The numbers (1 through 7) and the sum of each row (12) are simple to work with. To make it even easier the center number (4) is provided as a hint.

After explaining how magic puzzles work and showing students the first few, give each child a copy of the Magic I puzzle and a set of numbers. Most children can't wait to start, although others are not in such a big hurry. (This *is* after all, still math.)

The center number is the key to this puzzle. Since it must work in three rows (the two diagonals and the vertical) the only number that will work is 4.

Most children will use a guess-and-check method, trying various combinations adding up to 12 until they come up with a solution. For younger or less able math students you may want to suggest using 12 objects (Unifix cubes work really well), breaking the manipulatives up into three groups to find combinations of 12 that use three addends.

Here is one solution:



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MAGIC T

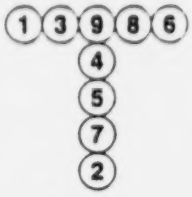
Use the numbers 1–9.

Each row must equal 27.

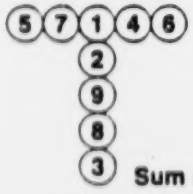
Notes on the Magic T

With the Magic T, the question is whether to teach the technique as described on page 12 or to allow the children to discover it for themselves. I generally try to allow children to work it out for themselves—and most do. I intervene when children seem particularly frustrated. Once the concept is explained, some children grasp it completely. Others use the information for the particular puzzle they're working on but are unable to apply the technique to the next one—they're just not ready. I leave it to you to judge the needs of your students.

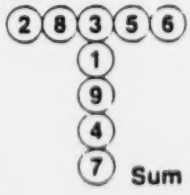
One solution to this puzzle is:



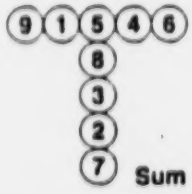
There are also solutions for the sums of 23, 24, 25, and 26. Each has a different number at the intersection point:



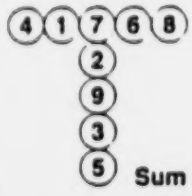
Sum = 23



Sum = 24



Sum = 25



Sum = 26

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APPENDIX E

LITERATURE BASED MATH LESSONS

LITERATURE BASED MATH LESSONS

Problem Solving

Lesson 1 Problem Solving
Mrs. Sato's Hens .....by Laura Min

Lesson 2 Problem Solving
Knots On A Counting Rope .....by Bill Martin Jr.& John Archambault

Lesson 3 Problem Solving
Where the Sidewalk Ends
'Bandaids'.....by Shel Silverstein

Lesson 4 Problem Solving
'Apples' .....by Avelyn Davidson

Lesson 5 Problem Solving
The Ghosts Dinner .....by J. Duquennoy

Lesson 6 Problem Solving
The House on Haunted Hill .....by Allyne Brumbaugh

Lesson 7 Problem Solving
Space Creature' .....by Addison Wesley

Lesson 8 Problem Solving
If You Sailed on the Mayflower..by A. McGovern

Graphing

Lesson 1 Estimation - Place Value - Graphing
Chrysanthemum .....by Kevin Kenkes

Lesson 2 Pictograph
When Autumn Comes .....by Robert Henry

Lesson 3 Graphing
Red Leaf, Yellow Leaf .....by Lois Ehlert

Lesson 4 Graphing
Night Tree .....by E. Bunting

Lesson 5 Graphing
Mr. Willeby's Christmas Tree....by R. Barry

Measurement

Lesson 1 Measurement
How Big Is A Foot .....by Rolf Myller

Lesson 2 Measurement - Fractions
Johnny Appleseed .....by Steven Kellogg

Lesson 3 Measurement
Inch by Inch .....by Leo Lionni

Lesson 4 Measurement - Counting
Mouse Count .....by Ellen Stoll Walsh

Lesson 5 Measurement
The Berenstain Bears
and the Prize Pumpkin .....by Jan & Stan Berenstain

Lesson 6 Measurement
Stellaluna .....by J. Cannon

Classification

Lesson 1 Classification
Frog and Toad Are Friends
'Buttons"..... by Arnold Lobel

Lesson 2 Classification
Soldiers, Poem: "Buttons" ... by Avelyn Davidson

Lesson 3 Classification
Corduroy .....by Don Freeman

Number Patterns

Lesson 1 Number Patterns
'Autumn' .....by Avelyn Davidson

Lesson 2 Number Patterns
Two of Everything .....by Lily Toy Hong

Lesson 3 Number Patterns
Even Steven and Odd Todd.....by K. Cristaldi

Lesson 4 Number Patterns
One Tough Turkey .....by Steven Kroll

Money and Time

Lesson 1 Money
The Lunch Line .....by Karen Nagel

Lesson 2 Telling Time
Just a Minute .....by T. Slater

Lesson 3 Telling Time
Clocks and More Clocks .....by Pat Hutchins

APPENDIX F

MATH BAG SURVEY

Math Bag Survey

Please share your thoughts about this Family Math Bag

Which activity did your child enjoy the most. Why?

_____

_____

_____

Do you think the Family Math bag is a good idea for us to continue? Why?

_____

_____

_____

If we were to continue the Family Math Bag concept, is there a math activity you would like to see included?

_____

_____

Please feel free to write any other comments on the back of this page!

APPENDIX G

TRADE BOOKS

Trade Books

Ahlberg, J.& A. (1986). The Jolly Postman. Boston: Little, Brown, and Company.

Barry, R. (1963). Mr. Willeby's Christmas Tree. New York: McGraw-Hill Book Company, Inc.

Berenstain, J.& S. (1990). The Berenstain Bears and the Prize Pumpkin. New York: Random House.

Brumbaugh, A. (1991). Math Stories. New York: Scholastic, Inc.

Bunting, E. (1991). Night Tree. New York: The Trumpet Club, Inc.

Cannon, J. (1993). Stellaluna. New York: Scholastic, Inc.

Cristaldi, K. (1996). Even Steven and Odd Todd. New York: Scholastic, Inc.

Davidson, A. (1985). Skittles. Shortland (Understanding Mathematics Series). Poems: "Autumn" and "Apples".

Davidson, A. (1984). Soldiers. Shortland (Understanding Mathematics Series). Poem: "Buttons".

Duquennoy, J. (1994). The Ghost's Dinner. Racine, Wisconsin: Western Publishing Company, Inc.

Ehlert, L. (1991). Red Leaf, Yellow Leaf. New York: Harcourt Brace & Company.

Freeman, D. (1968). Corduroy. New York: The Viking Press.

Henkes, K. (1991). Chrysanthemum. New York: Greenwillow Books.

Hong, L.T. (1993). Two of Everything. Morton Grove, Illinois: Albert Whitman & Company.

Hutchins, P. (1994). Clocks and More Clocks. New York: Macmillan Publishing Company.

Kellogg, S. (1988). Johnny Appleseed. New York: Scholastic Inc.

Kroll, S.(1982). One Tough Turkey. Connecticut: Viking Press.

Lionni, L. (1994). Inch by Inch. New York: Scholastic Inc.

Lobel, A. (1970). Frog and Toad Are Friends. New York: Harper & Row.

Maass, R. (1990). When Autumn Comes. New York: Henry Holt & Company.

Marshall, E. (1980). Space Case. New Mexico: Puffin Pied Piper.

Martin, Jr. & Archambault. (1966). Knots on the Counting Rope. New York: Henry Holt & Company,

McGovern, A. (1969). If You Sailed on the Mayflower in 1620. New York: Scholastic Inc.

Min, L. (1993). Mrs. Sato's Hen. Glenview, Il: Scott, Foresman and Company.

Myller, R. (1990). How Big Is A Foot. New York: Bantam Doubleday Dell Publishing Group.

Nagel, K. (1996). The Lunch Line. New York: Scholastic Inc.

Silverstein, S. (1984). Where the Sidewalk Ends. New York: Harper Junior Books.

Slater, T. (1996). Just a Minute. New York: Scholastic Inc.

Walsh, E. (1991). Mouse Count, New York: Harcourt Brace & Company.